

Training loads during training camps of the Brazilian Women's U 19 Beach Volleyball Team

Cargas de treinamento durante clínicas de treinamento da Seleção Brasileira de Voleibol de Praia Sub-19 Feminino

Cargas de entrenamiento durante los campamentos de entrenamiento del Equipo Brasileño de Voleibol de Playa Sub-19 Femenino

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Keywords:

Session rating of perceived exertion;
Team sport;
Training load
monitoring;
Grassroots players.

ABSTRACT

This study investigated the dynamics of training loads and neuromuscular responses in athletes from the training camps of the Brazilian Beach Volleyball Under-19 National Team. Seventeen athletes participated in two camps, with measurement of training load and neuromuscular responses through countermovement vertical jump (CMJ). High training loads were observed in both camps [913 A.U. (± 321) and 485 (± 236) A.U., respectively]. Regarding countermovement jumping, no significant difference was identified over days in both training camps. It is concluded that, despite the high training loads, there was no significant impact on the neuromuscular system.

Palavras-chave:

Percepção subjetiva de esforço da sessão;
Esporte em equipe;
Monitoramento das cargas de treinamento;
Jogadores de base.

RESUMO

Este estudo investigou a dinâmica das cargas de treinamento e as respostas neuromusculares em atletas durante as clínicas de treinamento (CT) da Seleção Brasileira de Voleibol de Praia Sub-19. Dezesete atletas participaram de duas CTs, com medição da carga de treinamento e respostas neuromusculares por meio do salto vertical com contramovimento. Altas cargas de treinamento foram observadas em ambas as clínicas [(913 A.U. (± 321) e 485 (± 236) A.U., respectivamente)]. Com relação ao salto com contramovimento, não foi identificada nenhuma diferença significativa ao longo dos dias em ambas as clínicas de treinamento. Conclui-se que, apesar das altas cargas de treinamento, não houve impacto significativo no sistema neuromuscular.

Palabras-clave:

Percepción del esfuerzo de la sesión;
Deporte en equipo;
Monitoreo de la carga de entrenamiento;
Jugadores de base.

RESUMEN

Este estudio investigó la dinámica de las cargas de entrenamiento y las respuestas neuromusculares en atletas de los Camps de entrenamiento del equipo nacional brasileño de voleibol playa sub-19. Diecisiete atletas participaron en dos campamentos, con medición de la carga de entrenamiento y respuestas neuromusculares a través del salto vertical con contramovimiento. Se observaron altas cargas de entrenamiento en ambos camps [913 A.U. (± 321) y 485 (± 236) A.U., respectivamente]. En cuanto al salto con contramovimiento, no se encontraron diferencias significativas entre ambos campos de entrenamiento a lo largo de los días. Se concluye que, a pesar de las altas cargas de entrenamiento, no hubo un impacto significativo en el sistema neuromuscular.

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INTRODUCTION

Beach volleyball is an intermittent team sport, thus, high-intensity periods are intercalating for rest periods (Magalhães et al., 2011). The work-to-rest ratio is approximately 1:3, with the rallies (i.e., the active game phase) occurring frequently between 4 and 7 seconds (Costa et al., 2021). Furthermore, beach volleyball players employ vertical jump skills in many technical-tactical actions (Pérez-Turpin et al., 2019). The player performs between 33 and 65 jumps throughout a single set (Medeiros et al., 2014; Natali et al., 2018). Moreover, the jump performance (i.e., height) can discriminate players of different levels (Batista et al., 2008). Finally, players' distance is ~550m per set (Bellinger et al., 2021). The training process is therefore designed to enhance the physical and technical-tactical skills required to meet the demands of the sport and to optimize performance.

In this sense, the improvement of the athlete's performance is a consequence of the positive adaptations to the training processes, and the monitoring of the loads is essential so that these adaptations can be achieved throughout the season (Debien et al., 2018). Impellizzeri et al. (2005) suggest that the increase in performance occurs due to the relationship between external load (i.e., training that the athlete is submitted to) and internal load (i.e., level of stress to which the body is imposed). Therefore, the key to an adequate training process is the precise monitoring of the loads, mainly the internal loads, since the same external load can cause different stress levels according to the athlete and individual abilities (Impellizzeri et al., 2005). When these parameters are neglected by coaches and other members of the coaching staff, some undesirable effects can be observed, such as overtraining (Kellmann, 2010). In this scenario, the athlete might experience persistent fatigue, which could be accompanied by negative physiological, biochemical, psychological, and immunological changes (Cunha et al., 2006).

In order to quantify internal training loads and avoid negative adaptations to training, several tools have been developed in recent decades to assist with this process (Alba-Jiménez et al., 2022; Nakamura et al., 2010). In this regard, Foster et al., (2001) proposed an approach based on the subjective perception of exertion (i.e., frequently measured using Borg's CR-10 scale) and session time (sRPE-TL), which has stood out mainly due to its low cost and easy application in different contexts (Nakamura et al., 2010), and showed good reliability (Haddad et al., 2017). Various sports have used this approach to quantify training loads. For example, Miloski et al., (2016), presented the dynamics of training loads with futsal players and demonstrated that higher training loads are employed during the pre-season; Similar to what was shown with volleyball players (Horta et al., 2019).

While this approach is beneficial, it is not without limitations. This instrument indicates the training load,

but it is not possible to detect the athlete's state of readiness and the type of fatigue [e.g., neuromuscular fatigue (Tornero-Aguilera et al., 2022)] using this approach alone. As several actions in beach volleyball depend on neuromuscular performance [e.g., vertical jump, short distance sprints (Costa et al., 2021; Magalhães et al., 2011)], it is essential to monitor the neuromuscular system. In this sense, Claudino et al. (2017), suggested after a literature review with meta-analysis that average countermovement jump height (CMJ) is an important tool to check neuromuscular status and fatigue. In general, high training loads are related to a reduction in countermovement vertical jump (Cruz et al., 2018; Gathercole et al., 2015). It can be reasonably deduced that the utilization of sRPE-TL and CMJ represents an appropriate method to monitor training load and fatigue for beach volleyball players, particularly when applied in combination.

Previously, the sTPE-TL was used in the beach volleyball context to analyze the load dynamic in a season (Oliveira et al., 2018), to compare internal load between training sessions with different intensities (Pelzer et al., 2020), and verify the difference between the load perceived by the athlete and planned by the coach (Andrade et al., 2020). Furthermore, it was suggested that this method can be employed with athletes at diverse skill levels (e.g., elite or amateur), genders, and in sessions with varying orientations as physical or technical-tactical conditioning (Lupo et al., 2020). Additionally, the countermovement vertical jump was utilized to assess neuromuscular function (Andrade et al., 2020; Pelzer et al., 2020). Nevertheless, the existing literature on training camps for beach volleyball, particularly for young athletes, remains limited.

In definition, "training camp" is a short period of training for learning or improving skills, and developing physical abilities (Ruf et al., 2023; Thornton et al., 2017). Sometimes these camps are utilized for specific championship preparation (McCall et al., 2018). Moreover, is very common to invite young players which are national highlights to offer the opportunity to use facilities similar to professional athletes and compete for vacancies to represent the country in international competitions. Thus, training camps are often used in many team sports, for instance, Thornton et al. (2017) presented data collected from professional rugby league players who participated in a 13-day training camp, while Ruf et al., (2023) presented data from soccer players who participated in a 5-day training camp.

Nevertheless, the dynamics of training loads during training camps and their effect on neuromuscular status for beach volleyball players remain to be elucidated. The data is of particular interest to coaches seeking to comprehend the dynamics of loads and their impact on neuromuscular function in the context of training camps. Furthermore, the data offers valuable insights into the effective monitoring of training loads in the context of beach volleyball. Therefore, this study aimed to analyze

the dynamics of the internal training loads, as well as the neuromuscular responses, through the evaluation of the countermovement vertical jump, in players during the training camps of the Brazilian Women's U 19 Beach Volleyball Team.

METHODS

This was a single-group, longitudinal observational study conducted during two training camps of the Brazilian U19 beach volleyball team. The players selected were housed in the Volleyball Development Center – Saquarema – BRA. These camps represent periods of physical and technical-tactical improvement, as well as evaluation of athletes to select national representatives for international championships (i.e., Beach Volleyball World Championship). In addition, these camps represent unique opportunities to bring together high-level athletes training in the same location, since during the year they are distributed across the country. The training load and neuromuscular fatigue were quantified based on sRPE-TL and CMJ, respectively.

PARTICIPANTS

Seventeen female beach volleyball athletes (Age = 17.81 ± 1.25 years; Height = 1.78 ± 0.06 m; Body mass = 4.85 ± 5.51 kg) were called up for the Brazilian Beach Volleyball National Team for training camp. All players knew the search objectives and procedures adopted. In this way, they agreed to participate voluntarily by signing the Informed Consent Form, constructed according to the Helsinki Declaration. Additionally, when the athlete was younger than 18 years old, the Term of Assent was used, and the legal guardian also approved the participation in the study. All procedures were previously approved by the Ethics Committee for Research with Human Beings (protocol nº 4.488.691).

INCLUSION AND EXCLUSION CRITERIA

Athletes who participated in at least 75% of the training sessions were included. If someone got injured or could not participate in training sessions together with

other players, the data were excluded from the analyses. This criterion did not need to be used.

EXTERNAL TRAINING LOAD

Two training periods were held at the Volleyball Development Center – Saquarema - BRA in February and June, respectively. The load of the sessions was aimed at a) technical-tactical development (at least one session per day in a group); and b) strength training (performed at the gym), as detailed described in Table 1.

INTERNAL TRAINING LOAD

Subjective perception of session effort – Training load (sRPE-TL): The sRPE-TL method was utilized as recommended by Foster and colleagues (Foster, 1998; Foster et al., 2001) to quantify internal training load. The players answer the question “How was your training session?” 30 minutes before the end of the training session. The CR-10 scale was used to respond, first, a descriptor was selected (e.g., moderate), and next, a quantification was indicated with a decimal number (e.g., 3.5). In addition, the session duration was noted. This information was utilized to calculate a) training load (arbitrary units – A.U.); b) monotony; and c) training strain (TS), by Table 2 equations.

Vertical countermovement jump (CMJ): The VERT Wearable Jump Monitor (VERT Wearable Jump Monitor, USA) was utilized to measure jump height, this tool was previously validated (Borges et al., 2017). The players received instructions to jump as high as possible with hands on the waist, flex the knees $\sim 90^\circ$, and change direction rapidly. The participants had experience with this test and if any failure was perceived (e.g., flexing the knee in the flight phase) the trial was canceled. Each athlete performed three validated attempts interspersed by 30 seconds of rest, using the mean of the three jumps as an indicator (Claudino et al., 2017).

STATISTICAL ANALYSES

The data was reported as means and standard deviation ($\pm$). Moreover, the General Linear Model (GLM)

Table 1. Description of training load used during the training camps.

Components of physical fitness		n	%	Description
February	Technical-tactical	17	73.91	- Sessions held in the sand involving movements in various directions, ball control, and improvement of beach volleyball skills.
	Strength	6	26.09	- Sessions are held at the gym with an emphasis on injury prevention, strength, and power. Moreover, was used core exercises and free weights.
June	Technical-tactical	9	75	- Sessions held in the sand involving movements in various directions, ball control, and improvement of beach volleyball skills.
	Strength	3	25	- Sessions are held at the gym with an emphasis on injury prevention, strength, and power. Moreover, was used core exercises and free weights.

n = number of training sessions; % = percentage of physical fitness components.

Table 2. Equations to calculate training load, monotony, and training strain.

Training Load	$sRPE - TL = Duration_{training\ session} * RPE$
Monotony	$Mt = \frac{Mean\ of\ TL}{DP\ of\ TL}$
Training strain	$TS = \sum TL * Mt$

Note: DP = standard deviation. Equations proposed by Foster et al. (2001) and Foster (1998).

with Bonferroni post hoc to compare training loads and CMJ was utilized. In addition, eta partial squared (η_p^2) was adopted as effect size, and interpreted following scale: small: 0.01; moderate: 0.09; large: 0.25, as Mesquita et al. (2019), previously. All procedures were performed in the software Jamovi 20.3.21 (The Jamovi project, Free License) with a significance of 5%.

RESULT

CAMP TRAINING 1

The mean value of the sum of the training load over 11 days was 10044 A.U. The mean of training load per day was 913.09 A.U. (DP $\pm$ 321.55), monotony 2.83, and TS 28521.15. Furthermore, Figure 1a presents the mean training load for each player daily. A significant difference was observed between training loads per day [$F(10.00\ 118.0) = 31.800$; $p \leq 0.001$; $\eta_p^2 = 0.729$ (large)]. About CMJ, the mean for the period was 49.24_{cm} (DP $\pm$ 6.63) and the mean for DP per player was 3.0_{cm} (DP $\pm$ 0.7). Figure 1b shows the means of the first day to last days intercalated. A significant difference on CMJ was not observed [$F(4.00\ 55.00) = 0.673$; $p = 0.613$; $\eta_p^2 = 0.047$ (small)].

CAMP TRAINING 2

The mean value of the sum of the training load over five days was 2429 A.U., The mean of training load per day was 485.80 A.U. (DP $\pm$ 236.14), monotony 2.05, and TS 4996.95. Furthermore, Figure 2a presents the mean training load per day for each player. A significant difference was observed between training loads per day [$F(4.00\ 55.00) = 20.600$; $p \leq 0.001$; $\eta_p^2 = 0.600$ (large)]. Concerning CMJ, the mean for the period was 54.39_{cm} (DP $\pm$ 8.10), and the mean for DP per player was 3.1_{cm} (DP $\pm$ 1.82). Figure 2b shows the means of the first, third, and last days intercalated. A non-significant difference on CMJ was observed [$F(2.00\ 33.00) = 0.282$; $p = 0.756$; $\eta_p^2 = 0.017$ (small)].

DISCUSSION

The purpose of this study was to analyze the training loads during training camps of the Brazilian beach volleyball team and neuromuscular responses. The coach staff seems to adopt an undulating training load distribution on training camp 1. In other words,

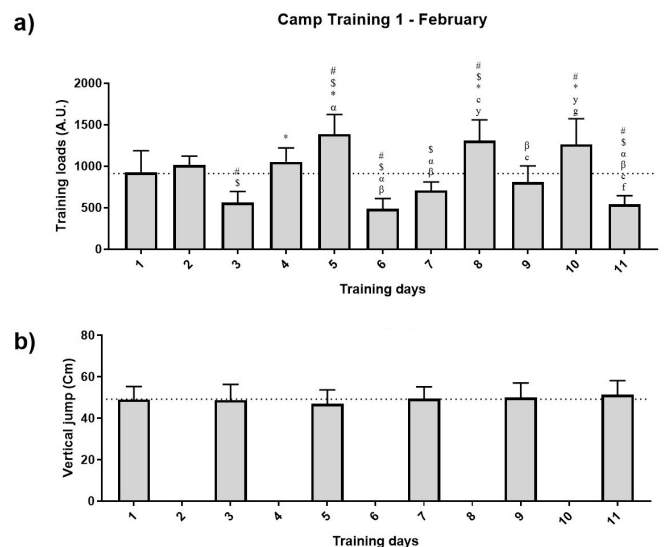


Figure 1. Comparison between internal training loads and CMJ of Camp Training – 1. Note: Significant difference ($p \leq 0.05$): [#]Vs. day 1; ^{\$}Vs. day 2; ^{*}Vs. day 3; [^]Vs. day 4; ^vVs. day 5; [^]Vs. day 6; [^]Vs. day 7; [^]Vs. day 8; [^]Vs. day 9. (a) Training loads; (b) Height of vertical counter movement jump (CMJ).

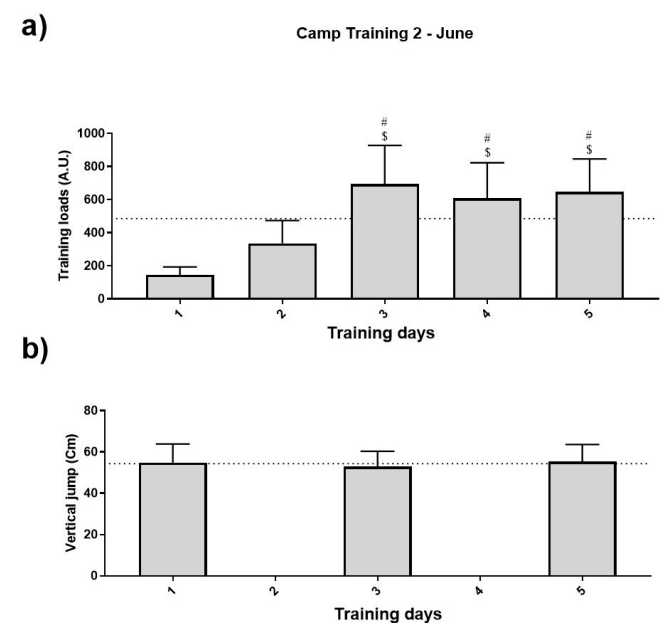


Figure 2. Comparison between internal training loads and CMJ of Camp Training – 2. Note: Significant difference ($p \leq 0.05$): ^{*}Vs. day 1; [#]Vs. day 2. (a) Training loads; (b) Height of vertical counter movement jump (CMJ).

the training load varies between high and low loads (e.g., Figure 1a – Day 2 Vs. Day 3). When a smaller number of days was available, the training load was distributed linearly, increasing the loads over the days. Moreover, substantial change was not observed on CMJ performance, the variation was approximately 3_{cm} in jump height. Coincidentally, the worst jump performance

was combined with the highest reported training load. These parameters are important indicators to better understand the stress effect induced by training load on neuromuscular function.

In a brief analysis of the similarity between the data reported by [Horta et al. \(2019\)](#) in relation to 20 weeks of a volleyball season, the results allow to identify that the training loads used in the training camp are similar to those used in the preparatory period of periodization. This training phase is characterized by the development of many different physical capacities (e.g., endurance, strength) and technical-tactical skills, therefore, the volume is high ([Mujika et al., 2018](#)). Moreover, [Miloski et al. \(2016\)](#), adopted a “high training load” when $TL \geq \sim 4000$ A.U., for futsal players. Considering the two training periods, the sum of loads exceeded this limit. Additionally, the more than 5000 A.U. reported, surpasses ~ 2000 A.U. observed in professional female players ([Oliveira et al., 2018](#)). Utilizing too much training load (>400 A.U.) was associated with a less stress tolerance ([Moreira et al., 2010](#)).

Furthermore, the monotony during a volleyball season doesn't exceed 2.0, regardless of the training phase ([Horta et al., 2019](#)). Nonetheless, the data, and the observed beach volleyball Olympics players ([Oliveira et al., 2018](#)), exceed 2.0. This can be explained by low training load variation ([Freitas et al., 2015](#)). Besides, when monotony is bigger than 2, the athlete seems more susceptible to infectious diseases and injuries ([Foster, 1998](#)). Thus, such concern seems to be confirmed when analyzing training strain, since it considers the product between training load and monotony. Compared to other studies, $TS \sim 5000$ AU, seems similar to Olympic players ([Oliveira et al., 2018](#)), but greatly exceeds professional teams of other sports, as volleyball ([Freitas et al., 2015](#); [Horta et al., 2019](#)).

Surprisingly, despite the high training loads, the mean CMJ height was quite stable, with the mean standard deviation of athletes being 3_{cm} , which represented $\sim 5\%$ variation. The vertical jump is an important tool for monitoring neuromuscular fatigue, and in general, has a variation between 2.8% and 5.3% ([Alba-Jiménez et al., 2022](#)). The equipment used for our has a variation of $\sim 7\%$ ([Borges et al., 2017](#)). Therefore, the results observed were in accordance with typical measure errors. Perhaps the strategy utilized influenced these results because CMJ performance was not measured for all days and/or pre-post training sessions. Previously it was suggested that after 48 hours the effects of neuromuscular fatigue are dispersed ([Kennedy and Drake, 2017](#)). In addition, a study with beach volleyball athletes failed to establish a relationship between training loads and vertical jump ([Pelzer et al., 2020](#)).

In addition, training camps are often designed to be intense training periods ([Thornton et al., 2017](#)). Given the limited time, coaches have with their players, whether for assessment or preparation for competition, training

loads are often associated with adaptive responses that are unfavorable. For example, the sleep quality of rugby players worsened during a training camp ([Thornton et al., 2017](#)). It is important to note that the athletes did not undergo a follow-up period following the training camp intervention. Generally, substantial performance gains from training are seen after 4 weeks and can be maximized ([Freitas et al., 2015](#); [Stanganelli et al., 2008](#)), and tapering period ([Beltran-Valls et al., 2020](#)). Furthermore, coaches should take into account the training history of the athletes before the commencement of the training camp to minimize the risk of injury ([McCall et al., 2018](#)).

In summary, this set of results can be explained by at least three factors. First, grassroots athletes are still not adapted to training routines practiced by professional athletes. In this camp training, they could experience daily sessions, and some say double training sessions. Second, although the loads seem higher compared to other sports, the studies discussed consider more weeks of training or the whole season, which necessarily requires greater flexibility of loads. Finally, beach volleyball is playing in an environment that offers greater demands (e.g., movement on sand) compared to other team sports ([Balasas et al., 2018](#); [Binnie et al., 2014](#); [Giatsis et al., 2018](#)), and most of the training session was technical-tactical performed in this environment. Therefore, athletes in this sport are expected to experience greater training loads. Moreover, the CMJ, as the main neuromuscular fatigue objective indicator used, did not detect severe fatigue in the athletes, even with these training loads.

Some limitations need to be presented. Training camps 1 and 2 had a short duration in comparison to studies that analyzed a season. However, in beach volleyball, it is unusual to gather this number of athletes under the same external loads, since the teams are distributed in several cities and training centers. Moreover, only an objective parameter was utilized to monitor the training load (i.e., CMJ). However, future research should adopt other parameters for monitoring stress induced by training load. In this sense, heat ratio variability and sport psychometrics scales [e.g., DALDA ([Moreira and Cavazzoni, 2009](#))] are low-cost ways and can provide valuable information about beach volleyball training. Furthermore, the longest periods of monitoring and follow-up after the camps appear to be the optimal approach for future research.

PRACTICAL APPLICATIONS

It is recommended that the information reported in this paper be widely used by coach staff since it provides parameters of how training loads were administered to outstanding athletes (i.e., Brazilian Beach Volleyball Team). As most athletes are not invited to participate in the Brazilian Beach Volleyball Team, our data demonstrate the training load design and can be reproduced in training centers distributed throughout

the country. In addition, we reformulated the need to monitor loads. Our suggestion is to use at least sRPE-TL and CMJ as monitoring methods.

CONCLUSIONS

In conclusion, during the training camp of the Brazilian Women's U-19 Volleyball Team, high training loads were used. In this way, it seems that an undulating and linear model was used for load distribution. These strategies may have prevented injuries and high neuromuscular fatigue.

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CONFLICTS OF INTEREST

The authors declare that there are no conflicts of interest in this study.

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