MONITORING STRESS LEVEL OF BRAZILIAN FEMALE BASKETBALL ATHLETES DURING THE PREPARATION FOR THE 2009 AMERICAN CUP

EXERCISE AND SPORTS MEDICINE CLINIC

ORIGINAL ARTICLE

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ABSTRACT

Objectives: 1) to investigate the influence of strength training periodization on profile of mood states (POMS) and salivary cortisol responses and 2) to verify the occurrence of the "iceberg profile" in the Brazilian women basketball team. Method: The study was conducted during the preparation period for the 2009 AMERICAN CUP, which included three discrete microcycles of strength training goals (Muscular Endurance, Maximum Strength and Power). The athletes provided saliva samples and subsequently answered the short-POMS questionnaire at baseline and following each microcycle. Results: ANOVA with repeated measures revealed no significant differences for mood state and cortisol responses during the observation period. Conclusion: The strength training periodization did not affect the salivary cortisol or mood state responses in the lead up to competition, indicating stability of the stress level. The "iceberg profile" was observed at all times evaluated.

Keywords: resistance training, mood disorders, cortisol.

INTRODUCTION

Athletes are usually submitted to high training loads with the goal to increment performance and reach the expected competitive results[1]. Moreover, the athletes are prone to different stress sources associated not only with the sports training itself, but also with other factors, such as pressure for results, interaction and daily life with their pairs, technical team, managers, media, supporters, family, to name some. Thus, it is acceptable to assume from this scenario, that these athletes are exposed to different stress agents of distinct magnitudes and that hence, stress of these individuals should be a target to be considered and monitored during the process of sports preparation[2].

These stress agents of different nature may promote psychological and physiological alterations[3]. For example, training intensification (deliberate or not), either by alteration in intensity, volume (quantity) or content, may lead the athlete to experience cute fatigue, alteration in the sleep pattern, eating habits, concentration problems, alterations in hormone responses, alterations in the mood states and imunosuppression[4,5]. These alterations in the response pattern of the psycho-neuro-imuno-endocrine axis may result in decrease in sports performance[4,5].

Considering that the stress level related to the complex sports training process modulates many organic responses, it is crucial to monitor these responses in order to maximize the chances of competitive success[6]. Among the many monitoring strategies of the stress level of the athletes and their aassociated responses, we highlight the self-analysis questionnaires.

One of the most used and reported in the literature questionnaire is named POMS (*profile of mood states*)[7]. Morgan *et al.*[8] investigated its sensitivity and use concerning the sports training monitoring. This classical study interested other sports researchers, which applied it with different aims, using varied outlinings[9-11].

POMS evaluates different mood states and from them a global scale od mood is designed. Moreover, the so-called "*iceberg profile*", characterized by high value of the positive scale and low values of the negative subscales, is expected in a population of athletes[8]. The alterations in the "*iceberg profile*", in the values of each subscale and in the mood global scale have been widely aassociated with the stress increase derived from manipulations of variables used in the organization of the sports training process, such as intensity[10,12], volume[11], or the combination of both[13,14].

Another way of monitoring the stress magnitude in the sports scenario is through the follow-up of the hormone responses. Among the many hormones, cortisol is one of the main physiological markers used for this goal. Uchida *et al.*[15] reported decrease in the rest concentration of cortisol after eight weeks of strength training in physically active women. According to the authors, this alteration indicates the onset of an adaptation to strength training which could favor the protein anabolism. Differently from the findings reported by Uchida *et al.*[15], Moreira *et al.*[16] observed increment in the concentration of salivary cortisol at rest after four weeks of training, during a competitive period, in basketball players. This response was aassociated with the stress tolerance markers and to the higher incidence of infections of the upper respiratory tract, suggesting increase in the stress level in that investigation moment.

Moreover, Filaire *et al.*[3] performed concomitant monitoring of cortisol as well as mood states, and reported increase in the cortisol concentration, at the same time at which increment in the negative subscales tension, depression, anger and fatigue, and decrease in the positive subscale vigor was verified, demonstrating the congruence between the alterations in mood states and in the cortisol concentration. These findings suggest the association between psychophysiological factors during the competitive season.

Despite the increasing interest in the monitoring of the psycho physiological alterations in elite athletes, there are not previous reports on the impact of different strength training contents on these alterations during the preparation for competition. Thus, the aims of the present study were: 1) to investigate the influence of the strength training periodization on the profile of the mood states and response of salivary cortisol; and 2) to verify the onset of the "*iceberg profile* " in athletes of the Brazilian women basketball team. The present study presents the hypothesis that the different strength training contents would promote different responses on the profile of mood states and cortisol concentration.

MATERIALS AND METHODS

Subjects

The sample was composed of 12 volunteer female athletes (26.2 ± 3.9 years, 183.1 ± 9.8 cm, 74.5 ± 10.1 kg) who were members of the Brazilian women basketball team in preparation for the American Cup 2009. The athletes participated during the season which preceded the preparation for the American Cup 2009 of national leagues in different countries and trained about ten to 12 weekly sessions. All the participants were informed about the risks involved in the study and signed a consent form approved by the Ethics in Research Committee of EEFE USP (2008/37).

Experimental timeline

The investigation tried to compare the responses of the mood states and salivary cortisol of female elite athletes for three different contents of strength training in the preparatory phase for the American Cup 2009. The athletes provided saliva samples, and subsequently, answered the reduced POMS questionnaire in four different moments during the 40 days of preparation. The first data collection moment occurred in the beginning of the preparation phase, one day after the athletes' presentation (Baseline). The other three collections were performed after the last day of training referring to each specific content: muscular endurance (ME), maximum strength (S) and power (P) (figure 1).

Planning of the strength training content

Planning of each content was based on previous recommendations [17] and adapted to the population of the study. In the ME phase two to four sets of 12 to 20 repetitions with load of 50-60% of one repetition maximum (1-RM) and one recovery minute between sets were performed. In the Strength period, three to five sets of 1 to 5-RM distributed in a pyramid pattern (one set of 5-RM, one of 4-RM, one of 3-RM, one of 2-RM, and one of 1-RM) with three minutes of recovery in each set were performed. In the Power content, three to seven sets of 6 to10 repetitions were performed (with maximum velocity) using 50% of 1-RM, with three minutes of recovery between sets.

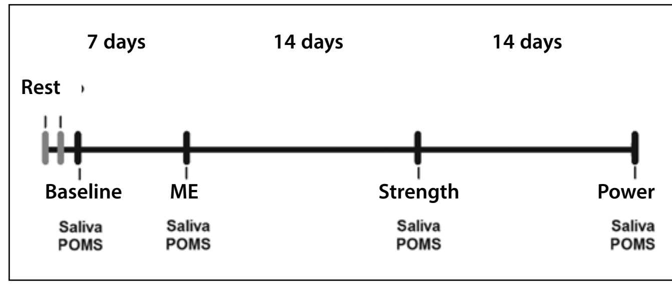

Figure 1. Experimental timeline.

Collection procedures and analysis of the saliva samples

The collections took place at 7:30 h, with the athletes fasting at the beginning and after the development of each specific mycrocycle, with different contents developed in each one of them, always after a complete day of rest. Saliva was collected and stored in sterile tubes at –80ºC until the analysis. The assay for the salivary cortisol analysis was performed with a commercial *kit* (Salivary Cortisol EIA kit, DSL©), according its instructions. The interanalysis variation coefficient was between 2.5 and 7.8%, based on the highest and lowest analyzed sample. The samples of each participant was assessed in the same assay to avoid interassay variation.

Profile of Mood States (POMS) questionnaire

A reduced version adapted to Portuguese[18] from the original and developed by McNair *et al.*[7] was used. In that adapted version, there is a self-evaluation of each athlete about 42 items, in a scale of five points, in which 0 represents "nothing" and 4 "extremely". Six different mood states are assessed, where five of them are negative (tension, depression, anger, fatigue and confusion) and one positive (vigor). The global mood scale consists in the sum of the five negative mood subscales followed by the subtraction of the positive mood, followed by the sum of 100 points, in an attempt to keep positive values for the following analysis, according to proposal by Morgan *et al.*[8] Thus, the higher the reached value, the higher the disturb in the global mood state of each athlete. In order to guide the responses, the athletes received instruction to answer "how the felt last week, including today" according to procedure indicated by Berger *et al.*[19].

STATISTICAL ANALYSIS

Initially, normality and homoscedasticity tests were used to observe distribution and its homogeneity. Analysis of variance (ANOVA) with repeated measures was used to verify the differences in the global mood state and in the six subscales for the four moments assessed, as well as for the cortisol concentration values, followed by Bonferroni *post hoc* test if needed. Level of significance was established in 5% ($p \leq 0.05$).

RESULTS

Table 1 presents the absolute values of each POMS subscale and the global mood scale (adding 100), considering mean and standard deviation concerning the group in each one of the four moments. No significant difference was found for each of the subscales concerning the global mood state between moments ($p \geq 0.05$).

The "*iceberg profile*" was observed–high values for the positive subscale (vigor) and low values for the negative subscales (tension, depression, anger, fatigue and confusion) at all moments (figure 2).

Salivary cortisol concentration did not show any significant change across all investigated periods of time (Baseline, ME, Strength and Power) (p>0.05) (figure 3).

Table 1. Score of the POMS subscales and total score (+100) during the different microcycles of strength training. Data expressed in mean ± standard deviation.

	Beginning	MR	Strength	Power
Tension	3.2 ± 5.9	3.2 ± 7.1	1.0 ± 4.6	0.0 ± 4.7
Depression	3.9 ± 5.3	4.6 ± 9.1	1.6 ± 2.7	1.0 ± 1.6
Anger	3.1 ± 4.3	1.7 ± 2.2	1.4 ± 2.3	0.8 ± 1.4
Vigor	16.0 ± 6.4	13.6 ± 5.6	13.8 ± 6.5	15.0 ± 5.6
Fatigue	6.1 ± 6	4.9 ± 4.9	3.5 ± 3	3.6 ± 2.1
Confusion	1.2 ± 2.2	0.6 ± 3	0.8 ± 3	0.2 ± 1.1
Total (+100)	101.5 ± 24.2	101.3 ± 26	94.5 ± 15.2	90.6 ± 11.1

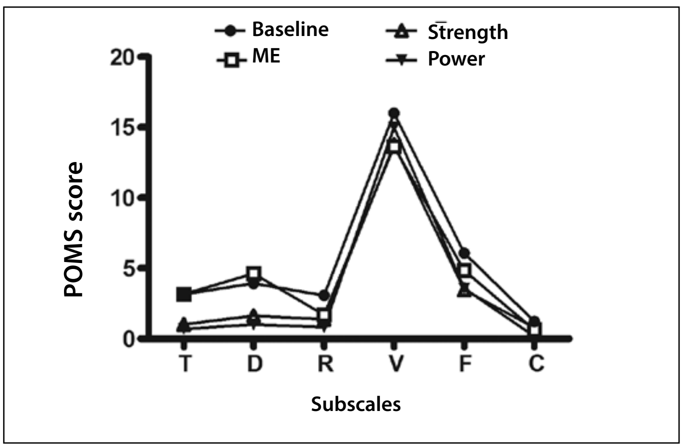

Figure 2. "Iceberg profile" during the different microcycles of strength training (Subscales: Tension [T], Depression [D], Anger [A], Vigor [V], Fatigue [F], Confusion [C]).

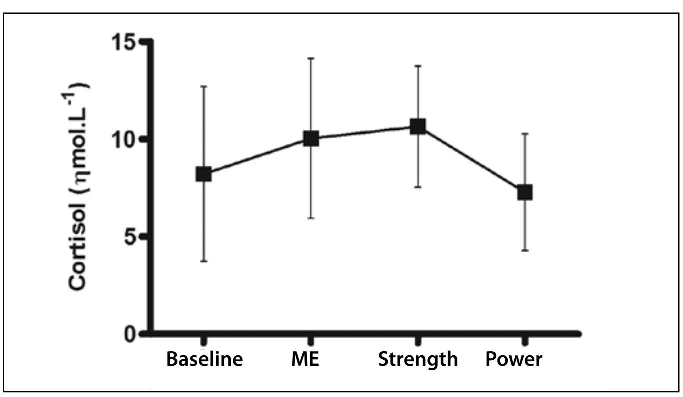

Figure 3. Salivary cortisol concentration during the different microcycles of strength training. Data expressed in mean ± standard deviation.

DISCUSSION

The aim of the present study was to investigate the influence of different contents of strength training on the mood states and salivary cortisol response. Another additional aim of this study was to verify the onset of the "*iceberg profile*" in athletes of the Brazilian women basketball team. The main findings of the investigation were: a) stability of the stress indicators, both psychological (mood state) and physiological (stress hormones) during the entire preparatory phase, regardless of the strength training content imposed to the athletes; and b) the onset of the "*iceberg profile*" for this population, as well as its maintenance in all the investigated moments.

Te stabilization in the mood states of the athletes found in the preparatory period found in the present study is in agreement with the findings by Faude *et al.*[13] and Rietjens *et al.*[14], despite the differences in the experimental outlining between the investigations. Rietjens *et al.*[14] demonstrated that despite of the increment in volume and training intensity of cyclists for two weeks, the answers for the POMS questionnaires were not different in the three moments (beginning, end of the first week and end of the second week of investigation). In that investigation the questionnaire was daily answered and the mean values of each week kept for analysis.

Additionally, Faude *et al.*[13] did not observe either difference for the mood states in their outlining with professional swimmers who went through two weeks of intensification and one of tapering. At the end of all the three phases (two of intensification and one of tapering), the POMS questionnaire was completed. No significant difference has been reported for the mood states for any of the two groups, in the analysed moments. These findings by Faude *et al.*[13], added to the results of the present study and the ones reported by Rietjens *et al.*[14], suggest that the mood state remains stable, regardless of the manipulations concerning the training variables, in athletes of different modalities and with distinct approaches.

However, Berger *et al.*[19] reported decrease of the global mood state of cyclists after three weeks of intensification of training load, followed by improvement after two weeks of tapering. Therefore, in a study using triathletes, Margaritis *et al.*[20] observed improvement in the global mood state between the beginning of the tapering period and after two weeks from its implementation.

Thus, it becomes evident the divergence in the results reported in the literature concerning the behavior of the mood states in athletes in the preparatory period. Nonetheless, this variation usually seems to be associated with the manipulation of the training variables (volume and/or intensity) implemented in different ways and in distinct modalities. Therefore, considering its idiosyncrasies, the present study showed there is no alteration in the mood states in the preparatory period, when only the strength training content was manipulated.

Besides the conventional use, performed for longer periods, the POMS questionnaire has also been used to investigate acute alterations of the mood state. For example, Rebustini *et al.*[12] reported alteration in the global mood state when comparing the pre and post values of a high-intensity intensity session. Additionally, Kenttä *et al.*[11], in a study with training intensification with kayak athletes, presented data which they called "*energy index*", result of the subscale vigor minus the subscale fatigue. Decrease in the *energy index* was reported in all the comparisons performed between the beginning *vs.* end of the day of intensified training[11].

Considering the findings by Kenttä *et al.*[11] and the results in the present study, the performance of future studies which investigate the profile of the mood states before and after a training session with different contents of strength training seems desirable and relevant. These acute responses could take additional information about the impact of the strength training content in the mood states, or even in specific subscales, such as vigor and fatigue.

Concerning the hormone response, no difference was observed between the baseline value of the cortisol after the microcycles with different strength training contents, a results different from what was presented by Uchida *et al.*[15], who reported decrease in the cortisol value at rest after eight weeks of strength training of physically active women. Possibly, the training level of the sample (physically active women *vs.* elite athletes) had been the main difference to explain this conflict between results, since these elite athletes are usually submitted to strength training programs. This constant exposure to strength training possibly promotes adaptations, minimizing the responses to stress.

Filaire *et al.*[9] performed an experiment with a team sport, and like the present study, observed that the mood states and the cortisol levels were kept steady and did not present difference in the before and after training intensification of professional soccer players. However, in the same study, decrease in vigor, increase in tension and depression at the moment of worst performance of the athletes, measured by the authors through percentage increase of the losses in the period was reported. In a subsequent study, Filaire *et al.*[3] reported very similar results; however, besides the decrease in vigor, increase in tension and depression, there was also increase in the subscale anger and increase of the baseline level of salivary cortisol at the moment with highest percentage of losses. These results highlight the importance and the impact of competition in the psychophysiological responses in team sports. The studies seem to indicate that even in the outlinings with training intensification, the psychophysiological response is not severely affected. However, when the athletes experience the competitive environment, there was increase in the salivary cortisol concentration and deconstruction of the "*iceberg profile*"[3,9]. This response to competition stress also appears in an acute way. In their study, Gonzales-Bono *et al.*[21], for example, present the responses of the mood states (POMS) and hormone alterations after an official basketball match. Cortisol increment was observed in the winning team and the team's win was correlated with increase in vigor (r = 0.79). Additionally, deconstruction of the "*iceberg profile*" was verified post-game for the losers.

These findings corroborate the relevance of an integrated approach of training monitoring, using psychometric instruments (eg.: POMS questionnaire) united with physiological parameters (eg.: cortisol concentration). Considering that the results reported in the literature suggesting that the competitive period causes higher psychophysiological alteration in the athletes, monitoring in this phase may suggest slight alterations in the planning in an attempt to reestablish the optimum psychophysiological condition of the athlete. This kind of follow-up may favor maximum performance of the athlete, which is the main goal of the entire process of sports preparation.

The "*iceberg profile*" is frequently observed in elite athletes, being used as an indicator of "mental health"[8]. The findings of the present study reinforce its presence, corroborating the initial hypothesis that the athletes investigated in this study would present this characteristic.

Moreover, in the present investigation, the athletes presented stability in the "*iceberg profile*", when compared with the initial and the other moments analyzed in the study. This finding has also been demonstrated in the vast majority of the studies with athletes[3,11,13]. Despite the relative consensus concerning the results of the mentioned studies, recently, Hadala *et al.*[10] presented high scores of the subscales anger and tension in sailors, when they faced a pre-competition situation, deconstruction hence the "*iceberg profile*". Once again the influence of the pressure for results becomes evident in the mood states of athletes, which in this case signaled that the alteration may occur previous to the competition. These results indicate the need for further studies on monitoring in different phases of the season and in different sports modalities.

CONCLUSION

The different contents of the strength training, used in the preparation phase for competition did not affect the mood status or the salivary cortisol response, indicating stability of the stress level of the athletes. The results show the onset of "*iceberg profile*" in the present study in all the evaluated moments. The majority of the evidence available suggests that these mood and hormone status responses suffer greater alteration during competition; therefore, their investigation during competitions would be of great value.

All authors have declared there is not any potential conflict of interests concerning this article.

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