Effect of a Mental Training Program on Salivary Cortisol in Volleyball Players

Ricardo Weigert Coelho, Katia Maria Kuczynski, Mayara Juliana Paes, Dênis de Lima Greboggy, Priscilla Bertoldo dos Santos, Ana Paula Dalazuana Souza Rosa, Joice Mara Facco Stefanello

Federal University of Paraná – Brazil. Sector of Biological Sciences – Postgraduate Program in Physical Education, Curitiba - PR, Brazil

ABSTRACT

Coelho RW, Kuczynski KM, Paes MJ, Greboggy DL, Santos PB, Rosa APDS, Stefanello JMF. Effect of a Mental Training Program on Salivary Cortisol in Volleyball Players. JEPonline 2014;17(3):46-57. The purpose of this study was to investigate the effect of a program of relaxation, behavior modeling video, and imagery on salivary cortisol in volleyball players. The quasi-experimental design included 53 male and female elite volleyball athletes. The data were analyzed by a 2 (experimental and control) by 2 (male and female) multifactor analysis of covariance with repeated measures at a significance level of P<0.05. The findings demonstrated a significant main effect between the experimental and control groups, thus indicating that the mental training program had a significant effect on salivary cortisol concentration.

Key Words: Stress, Imagery, Athletes, Cortisol
INTRODUCTION

Increasingly, researchers, athletes, and coaches are getting the message that psychological factors can either help or distract from a good athletic performance (9,12,24,30). Stress, in particular, is by far the most studied phenomenon in sport psychology. The pressure that athletes feel in competition is enormous, and it threatens their psycho-physiological health. This fact alone has resulted in the search for a suitable and consistent intervention to control the negative effects of stress-related behavior. Yet, there is still a tremendous amount of work and research that must be done to fully understand the challenges before athletes and coaches.

While there are many definitions of stress by prominent sports psychologists, Martens (29) states that stress emerges from two distinct situations in sports. First, stress is associated with the importance of the athletes’ desire to perform well. Second, the uncertainty of the outcome is always stressful. This is especially the case when competition is driven a powerful need to win. After all, athletes do not like to be defeated. Also, there are external pressures, particularly from the athletes’ peers and teammates. The effects of stress are always difficult to deal with when there is the sense of a threat or a demand to perform in a certain way (11). Most athletes learn to cope with the stress by developing certain coping skills. Yet, as Lazarus and Folkman (26) indicated, the effect of stress depends on the transaction between the person and the environment, assuming that individuals actively interact with their environment. Many models have been proposed by researchers to explain the connection with a person’s environment (18). Most of the models have relied on indirect instrumentations to access data collection, which often leads to a limited generalization of the findings.

The use of physiological and biochemical indicators (e.g., blood and salivary cortisol) brought a new perspective in understanding the effects of stress. Cortisol, the most important glucocorticoid, is synthesized by the adrenal cortex and can be assessed by salivary, urinary, and plasma testing. The advantage of the salivary cortisol measurement over plasma testing is that it is both an easier and a noninvasive assessment of cortisol (22). Salivary cortisol has been commonly used as a biomarker of psychological stress and related mental and/or physical diseases (20). It is also a reliable indicator of hypothalamus-pituitary-adrenal (HPA) axis functions (43). When a competitive demand is perceived, the HPA axis is activated resulting in an increase in cortisol. After the effect of the stressor has been resolved, cortisol returns to basal level (20).

Given the role of psycho-physiologic stress in elevating cortisol (1,16), it is important to help athletes learn and use different psychological intervention to decrease the harmful effects of stress on the immune system (38). As an example, the practice of mental imagery by athletes is believed to be an excellent method to reduce stress and perform better in competition (27). Imagery is understood by the central nervous system as an imitation of the actual neuromuscular events required of a particular movement pattern. It involves most of human senses and perceptions, including but not limited to, tastes, smells, sensitivity, visualization, and sound of movement and/or a specific situation without actually performing the action (32,50). In this regard, Pavio (35) asserted that motivational general arousal imagery (MG-A) is when the athlete imagines himself in a situation of risk, but learns to reverse the situation by taking control through positive imagery to reduce anxiety and stress (25).

The connection between imagery and stress has been advocated by many behavioral scientists for many years now, including Pavio (35) in his multidimensional model, which was followed by the work of Hausenblas and colleagues (19) in their exercise imagery model. Imagery is one of the most commonly used psychological interventions to improve sport performance (48) by controlling
anxiety and stress (10). Imagery also improves confidence and efficacy (44,45), which encourages the learning of specific motor skills (8). To better understand these outcomes, researchers have used a variety of different research tools that include Transcranial Magnetic Stimulation (26), Functional Magnetic Resonance Imaging (6), and Electroencephalogram. TMS is a noninvasive stimulation of neurons in the cortex regions, FMRI is used to assess cortical effects, and EEG is used to measures beta oscillations in the brain (38). Despite the validity and the precision of the different research instruments, the technology is very sophisticated and often times difficult to assemble and use in real sports’ competitive settings. This requires a great deal of manpower, resources, and effort. That is why the option of using hormone analysis, mainly salivary cortisol, is both practical and easier to use.

Guillot and colleagues indicate that imagery has been shown to increase flexibility (14), which is especially helpful in performing motor skills with a prerequisite for strength and power, and as well in the changes that undergird Movement Related Brain Macropotentials (13). Results also show that mental imagery is associated with improvement in physical practice of adolescents with mental retardation (21). Psychological interventions such as goal setting, positive self-talk, relaxation, and imagery are commonly used psychological interventions that can assist athletes in their recovery from injury (34).

Progressive relaxation training is a cognitive technique that enables individuals to control their focus of attention (49), as well as reduce anxiety in response to different stressors. It is also used to increase athletic performance (36). The idea underlying the use of imagery in stress reduction is that a person’s imagination is used to create and enjoy a situation that is very relaxing. By imagining a pleasant scene, with the purpose to reduce anxiety and stress, it is possible to reduce stress throughout the body. Conversely, by imagining an unpleasant and stressful situation, a person can feel the increase in stress. One common use of relaxation imagery is to imagine a scene, place or event that is remembered as safe, peaceful, restful, beautiful, and happy (8).

Pawlow and Jones (37) investigated the acute effects of relaxation training, using the method of progressive relaxation on salivary cortisol and salivary immunoglobulin A (sIgA). Their results indicate that the immune system can benefit when relaxation takes place (16). In fact, their findings are very important because they add to the support of future research that continues to investigate the degree to which even a relatively brief relaxation session can significantly alter the immune and endocrine responses in adults (28).

An additional method of improving athletic performance is the technique of video modeling. It is supported by the social learning theory of Bandura (2), who proposed that most habits acquired by humans are the result of observation and imitation of others. Thus, by watching the execution of an athletic skill by an expert, it becomes easier to create similar patterns of movement. Many young athletes imitate their idols by adopting their identity. Watching role models in action (video, television, live) helps athletes to see how their idols stay focused and, as well, how they react to mistakes in performance. Learning occurs when athletes carry a cognitive representation of these images as their own motor performances (32). Boyer et al. (5) analyzed the effects of combining video modeling experts with video feedback and found that the athletes (i.e., gymnasts) improved their performance more quickly than with just regular practice. The intervention also reduced the number of practice sessions required to improve difficult physical skills.

The purpose of this study was to investigate if a mental training program intervention, involving imagery, relaxation, and video modeling would have a beneficial impact on stress reduction through measuring cortisol concentrations in a real competitive setting.
METHODS

Subjects
The recruitment and selection of the involved a scheduled visit with the coaches along with a letter explaining the purpose of the research and the procedures involved. A total of 53 elite volleyball players (28 males and 25 females) with an age range of 14 to 24 yrs with at least 2 yrs of experience in competition volunteered to participate in this study. The subjects practiced 5 days·wk⁻¹. The subjects were divided into the experimental group (14 females and 14 males) and the control group (11 females and 14 males). This study was approved by the Ethics Committee of the Federal University of Paraná State, Brazil. All subjects provided a written informed consent before participating in the study.

Research Design
This investigation was carried out using a quasi-experimental design (experimental x control groups) with repeated measures. The Hawthorne effect was controlled by choosing athletes from different sports clubs in Brazil. Saliva was sampled using a Salivette sampling device (44) that contains a small swab in a plastic tube. The swab was removed from the suspended insert, and the athlete gently chewed on it for 120 sec to produce a sufficient quantity of saliva. The samples were then centrifuged and stored in a freezer for posterior analysis. Free cortisol in saliva was assessed using a saliva cortisol kit DSL-10-671000 Active® (Cortisol EIA Kit). The data were collected by the same researcher at rest before a regular training day (baseline measure) and, then, 5 min before the competition got underway (pre-test). At the end of the competition, there was an intervention to reduce stress whereby another collection took place 5 min prior to first game of the other competition (post-test).

Imagery, Relaxation, and Video Modeling
The intervention consisted of 5 min of a video modeling behavior that was edited specifically to meet the research objectives. The intervention showed how winners behave along with their decision making, strategies, attitudes, and body language, which was followed by 5 min of progressive relaxation, 5 min of imagination where by athletes were encouraged to reverse unfavorable and stressful situations to positive thoughts and success in their competition performance (imagery MG-A). The intervention consisted of 15 sessions, 3 times·wk⁻¹ on alternate days. New sample saliva was collected with the same protocol at the end of the intervention period.

Statistical Analysis
The effects of treatment of imagery on cortisol concentrations were analyzed by a two (experimental and control) by two (male and female) multifactor analysis of covariance (ANCOVA) with repetitive measures at a predictive level of P<0.05. ANCOVA was applied to control inter-subject differences and cortisol circadian cycle by controlling the baseline scores (covariate measure). The Shapiro–Wilks and Levene tests were applied to check for normality and homogeneity. The Hawthorne effect was controlled by choosing athletes from different sports clubs in Brazil.

RESULTS
Baseline pre- and post-test mean scores and standard deviation for salivary cortisol as a function of the mental training program and no imagery of male and female athletes are shown in Table 1. The findings demonstrated significant main effect among variables. The factor experimental x
control was significant at $P<0.001$ and the interaction was also significant (male x female and experimental x control). The results also demonstrated that there was no significant main effect between males and females athletes. These results showed that psychological skills training had a significant effect in the salivary cortisol concentration levels (Table 2, *$P<0.05$, **$P<0.01$).

**Table 1. Baseline, Pre- and Post-test Mean Scores and Standard Deviation for Salivary Cortisol as a Function Mental Training Program and No Imagery (Mean ± SD).**

<table>
<thead>
<tr>
<th></th>
<th>Baseline</th>
<th>Pretest</th>
<th>Posttest</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Multimodal Imagery</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female (N = 13)</td>
<td>.3092 ± .10012</td>
<td>.3036 ± .12438</td>
<td>.3186 ± .07873</td>
</tr>
<tr>
<td>Male (N = 14)</td>
<td>.2336 ± .06535</td>
<td>.3429 ± .16592</td>
<td>.2593 ± .12200</td>
</tr>
<tr>
<td><strong>No Imagery</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female (N = 11)</td>
<td>.2450 ± .13495</td>
<td>.1723 ± .04640</td>
<td>.3100 ± .12973</td>
</tr>
<tr>
<td>Male (N = 14)</td>
<td>.3671 ± .13335</td>
<td>.2221 ± .07728</td>
<td>.2762 ± .05881</td>
</tr>
</tbody>
</table>

**Table 2. Analysis of Covariance of Pre-test and Post-test Cortisol Scores as Function of Mental Training Program and No Imagery Condition of Female and Male Volleyball Athletes.**

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>SS</th>
<th>MS</th>
<th>F</th>
<th>$\eta^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Covariate (baseline cortisol)</td>
<td>1</td>
<td>.071</td>
<td>.071</td>
<td>4.208*</td>
<td>.078</td>
</tr>
<tr>
<td>Experimental x Control (EC)</td>
<td>1</td>
<td>.077</td>
<td>.013</td>
<td>4.519*</td>
<td>.083</td>
</tr>
<tr>
<td>Female x Male (FM)</td>
<td>1</td>
<td>.003</td>
<td>.003</td>
<td>.190</td>
<td>.004</td>
</tr>
<tr>
<td>EC x FM</td>
<td>1</td>
<td>.052</td>
<td>.052</td>
<td>3.086*</td>
<td>.058</td>
</tr>
<tr>
<td>Error</td>
<td>50</td>
<td>.848</td>
<td>.017</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**DISCUSSION**

It is apparent that a robust stress reduction intervention that helps to control stress in athletics is critically needed. Because salivary cortisol levels are positively correlated with stress levels, the changes after the intervention in the present study suggest a reduction in the athletes’ stress. The novelty of this study lies in the fact that the physiological variable, cortisol, was used to understand
the athletes’ stress levels. Mental imagery has been shown in numerous research studies to be an effective means to improving accuracy in sport (33), and it is also related to other important psychological conditions such as confidence (17), and self-efficacy (45).

Hall et al. (17) investigated the athletes’ use of observational learning and imagery during training and competition and how both related to confidence in the sport. They found that nearly all of the imagery functions were more frequently used during competition; whereas, the majority of observational learning functions were used more for training purposes. Cognitive specific and motivational general-mastery imagery were significant predictors of sport confidence in training and competition. The skill function of observational learning significantly predicted training confidence only.

Why some athletes use imagery and others do not is not fully understood. One consideration may be the athletes’ confidence in creating images of specific motor patterns. In agreement, Short et al. (45) examined the relationships among efficacy in using imagery, imagery use, and imagery ability in female athletes from various sports. Their work showed that when athletes were confident in their ability to use a certain image, they used imagery more often in their sports training. Efficacy in using imagery was found to mediate only the relationship between imagery ability and cognitive imagery use.

Additional evidence that imagery is used as an important tool to improve athletic performance is reported by Coelho et al. (9) who investigated junior tennis players in Brazil. Similarly, but with a different sport, Shoenfelt and Griffith (46) reported that the introduction of key mental skills during preseason enhanced service performance of intercollegiate volleyball athletes. The mental skills included relaxation, imagery, attentional focus, goal setting, behavioral modeling, and performance routine.

The effectiveness of imagery to improve athletic performances is closely linked to the ability to generate meaningful and vivid images. Hence, it is important to evaluate motor imagery ability in subjects with no experience (31,47). In agreement, Hall and colleagues (15) used a sports imagery questionnaire (15) before and after imagery training to measure imagery ability. Retention (RET) was assessed 2 wks after training. Comparison of the imagery training conditions (training alone, training accompanied, observing a colleague, and during assessment) showed no differences between the pre-treatment, post-treatment, and RET evaluations. Although imagery ability did not respond to training, significant differences between imagery domains (visual, auditory, and kinesthetic) were found. These differences might be related to subject’s domain preference during the imagery process.

Researchers have used video as an aid in the practice of imagery in sports (32). Findings provide one more reason to investigate the effects of video imagery: Individuals who lack vivid imaging skills may find that a video re-enactment of the task allows them to see the desired performance more clearly. Hence, the use of video imagery as a complement to mental preparation for an actual event seems warranted. Nelson et al. (33) investigated whether imagery would have an effect on the throwing performance and sought to determine if individual variation in ability to image is associated with distinct responses to cognitive imagery interventions and video. Their results showed that 2 participants (i.e., pitchers) demonstrated an increase in performance, while all participants expressed a desire to continue to use imagery for its various effects.

Barzouka and colleagues (4) used self-modeling of volleyball skill acquisition in 53 pupils 12 to 15 yrs old. The research design consisted of two experimental groups and one control group. The
subjects followed an intervention program for 12 practice sessions. Results showed equivalent improvement in all three groups at the end of the intervention program. Self-modeling was demonstrated to be an effective means to the acquisition and retention of the motor skills in volleyball. This study indicates the effects of mental training, though, there have been studies correlating imagery with stress in competitive sport, which explains the purpose of this study, where the results indicated that there is influence of the experimental treatment (imagery) in reducing the levels of salivary cortisol in volleyball athletes. This demonstrates a close relation to the subjects’ psychophysiological responses that suggest the need to use different strategies for stress management in sports training.

When comparing men and women in these studies, there were no significant differences in salivary cortisol concentrations. This finding is in agreement with Pistilli et al. (39) who compared the concentrations of salivary cortisol among older and younger runners. They found that both had similar results after completing the marathon, and there were no significant difference between men and women. The findings of the present study also confirm that there is a ‘cause and effect’ relationship between imagery and cortisol concentrations. This is an important finding, especially since it highlights the psychophysiology of athletes. Thus, increasingly, coaches and athletes are responsible to factors that influence the mind and body. This finding is essentially in agreement with Bara Filho et al. (3). They reported that the influence of progressive relaxation decreased salivary cortisol levels in swimmers.

Additional studies are needed to determine the level of stress not only in volleyball athletes, but in athletes of different sports. Another important variable to be taken into consideration is the comparison between athletes and substitutes, as well as identifying the level of stress among beginners and experienced athletes. It is likely that the time allocated to a program of relaxation, the behavior modeling video, and imagery on reducing stress was not enough. The dedication of more learning time might have been appropriate, considering that the most problematic aspect of the intervention was that the sessions were held collectively and not individually.

Also, it is important to plan for the experience level of players (i.e., according to the retention capacity of the images required), which creates difficulties in global training when individual capacity of imagery (41) is taken into account. Hence, while the protocol used in this study provided the opportunity to examine the effects of mental training program on cortisol concentrations, it did not control for individual imagery ability (40) that has two key characteristics: vividness and controllability (7). Imagery ability is often measured via introspective reports of the vividness (i.e., the clarity and realism) of imagery experiences through validated questionnaires.

CONCLUSIONS

The findings demonstrated a significant main effect between the experimental and control groups, thus indicating that the mental training program had a significant effect on salivary cortisol concentration. Because salivary cortisol levels are positively correlated with stress, the changes suggest a decrease in the athletes’ stress. However, since individual capacity to use imagery to improve stress management in sports is likely to be low in athletes with poor imagery abilities, subjects should be screened according to imagery ability scores.
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Address for correspondence: Katia Maria Kuczynski, Federal University of Paraná - Department of Physical Education, R. Coração de Maria, 92, Jardim Botânico – Curitiba–PR–Brazil – Zip code: 80215-370, Email: kuczynskikatiamaria@gmail.com

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