



# The Effectiveness of Mindfulness-Based Cognitive-Behavioral Strategy Training on Cognitive Emotion Regulation Strategies and Salivary Cortisol Levels in Endurance Runners: A Three-Month Follow-up

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## Abstract

**Background:** Exposure of the athlete to stressful situations in addition to physiological effects will cause the person to feel excited in response to those situations and these changes may have dangerous consequences.

**Objectives:** This study aimed to investigate the effectiveness of the mindfulness-based intervention on cognitive-emotional regulation strategies and salivary cortisol levels in endurance runners with a three-month follow-up.

**Methods:** The research method was experimental with a pretest-posttest follow up design with a control group. The study population consisted of all beginner endurance runners with age range 16-18 who were voluntarily invited to participate in this research. Twenty-four male beginner runners (mean aged  $17.08 \pm 0.64$  years and athletic background  $7.7 \pm 1.6$  month) were divided into two groups of Mindfulness-Based Intervention (MBI) and control. The intervention protocol of the experimental group consisted of six sessions of mindfulness training and daily homework assignments that were performed under the researcher's supervision and with the help of a qualified clinical psychologist. Salivary Cortisol Kit (SCK) with sensitivity  $0.05 \mu\text{g/dl}$  was used to measure stress and the Gross and John Emotion Regulation Questionnaire was used to assess cognitive-emotional regulation strategies.

**Results:** The results showed a significant difference in cortisol levels, suppression, and reappraisal, between the MBI and control groups in posttest and follow-up steps. The findings showed that salivary cortisol concentration in the MBI group was reduced from pretest ( $1.09 \pm 0.16$ ) to posttest ( $0.76 \pm 0.15$ ) and follow-up ( $0.72 \pm 0.07$ ). Also, the suppression component in the MBI group was reduced from pretest ( $21.40 \pm 1.64$ ) to posttest ( $15.10 \pm 1$ ) and follow-up ( $16 \pm 1.15$ ) and increased the reappraisal component from pretest ( $22.40 \pm 1.17$ ) to posttest ( $29.10 \pm 2.37$ ) and follow up ( $27.70 \pm 2.21$ ) (P value = 0.0001).

**Conclusions:** The findings showed that MBI reduced salivary cortisol concentration and suppression component, while increased the reappraisal component of emotion regulation. The findings suggest that MBI can be used as a new promising method on cognitive emotion regulation strategies and salivary cortisol levels in endurance runners.

**Keywords:** Mindfulness, Cortisol, Emotional regulation, Athletes

## 1. Background

In recent years, many sports psychologists have shown that psychological skills are the most important variables affecting professional athletes' success (1). Psychological skills training improves athletic performance by controlling thoughts and emotions, regulating arousal, improving attention and concentration, self-confidence, changing the evaluation method from a competitive environment, and managing stress and it will help athletes perform their desired performance both in training and in high-competitive conditions (2, 3).

Undoubtedly, athletes at any level and in any sport

may face a lot of pressure from competition environment (1). Research has shown that being in a competitive environment under pressure for athletes, in addition to experiencing stress in the psychological dimension, also has physiological responses (4-6). Any physical or psychological stress stimulates the hypothalamus and releases corticotropin-releasing factor, which eventually leads to increased cortisol secretion from the adrenal gland (6). The end-product of the hypothalamic-pituitary-adrenal (HPA) axis is cortisol. This axis plays an important role in the body's homeostasis and is activated in the face of psychological and physical stress conditions and

the dangerous physiological effects of these changes may be of great concern (7). In addition to physiological complications, the athlete's exposure to stressful conditions will cause the person to feel excited in response to those situations (8).

One of the main areas of emotional activity is arousal and its regulation in response to stressors. In this regard, emotion regulation strategies are considered stress-coping strategies (9). Cognitive emotion regulation strategies have been applied to how individuals think after a negative experience or traumatic event (10).

Studies show that individuals in the face of stressful events use different emotion regulation strategies to modify and modulate their emotional experience (11). One of the models proposed in this context is the Gross emotion regulation model (1988), which is examined in two important contexts of the reappraisal process and suppression (12).

One of the new interventions used today in the treatment and prevention of many psychological disorders and problems is mindfulness-based interventions. Mindfulness means paying attention to the present in a specific, purposeful, and judgment-free manner and increases awareness, decentralization, allowing unpleasant thoughts and emotions to emerge (13, 14). The mindfulness consists of openness and non-judgment awareness of what is happening now. Mindful individuals perceive the mind internally and externally realities freely and without distortion, and are capable of coping with a wide range of thoughts, emotions, and experiences, both pleasant and unpleasant (15).

The effectiveness of MBI on variables such as sports performance (16), flow (3, 17), anxiety (13, 17), worries and task-irrelevant thoughts (18), and physiological variables (19) have been shown in previous studies. However, few studies have investigated the effect of MBI on emotion regulation and pre-competition stress. For example, MacDonald and Minahan (2018) showed reduced salivary cortisol levels in wheelchair basketball players following their eight-week mindfulness program (20). In their research, Rocky and Naderi (2018) reported the positive effect of mindfulness program on improving cognitive emotion regulation and anxiety in female athletes (21). Joseffson et al. (2019) reported reduced emotion regulation difficulties following the mindfulness-acceptance and commitment program in elite athletes (22). However, in their research, Baltzell and Akhtar (2014) did not find a significant effect on decreasing negative emotions (23). Even though the benefits of MBI have been demonstrated in various sports (13, 16-18), the results are contradictory (23, 24).

Although the brain alone has often been the focus of attention in psychological studies, there has been a great

deal of recent attention to the role of hormones through which the brain exerts its behavioral control and how it affects the brain. Also, the assessment of physiological responses may provide a better understanding of the athlete's stress in official competitions (25). Besides, most research has focused on elite and skilled athletes, and less research has been done on beginner athletes. Also, despite the need to evaluate the long-term effectiveness of interventions, few studies have followed up on their training programs and reported only the immediate effects of their programs.

## 2. Objectives

The purpose of the present study was to investigate the effectiveness of mindfulness intervention training on cognitive emotion regulation strategies and salivary cortisol levels of on male beginner endurance runners with a three-month follow-up.

## 3. Methods

The present research method was experimental with a pretest-posttest-follow-up design with a control group. The statistical population of the study consisted of male student-athletes (16-18 years old) in the endurance running who were called to participate voluntarily in the study. In this study, 24 athletes were randomly divided into experimental and control groups. To select the samples, the participants' consent form, psychological and physical health, and activity history were collected. The inclusion criteria were less than a year of athletic experience in the endurance running and the experience of participating in provincial competitions, as well as physical and psychological full health. The exclusion criteria were the lack of regular participation in training sessions and not doing homework assignments. According to the information obtained from the instructor and athletes, none of the subjects had a history of attending psychological classes and it was their first experience. After selecting the qualified individuals according to the information obtained from the questionnaire and after the explanation of the purpose of the study for subjects, written informed consent and commitment forms of the participating in the class and test were collected. The psychological training program was conducted under the supervision of a researcher with the help of an experienced clinical psychologist. Subjects in the experimental group participated in six training sessions specified over six weeks (one 70 to 90-minute session in a week). The mindfulness intervention program included stretch training, sedentary meditation fo-

cused on breathing, body checking meditation, yoga practice, walking meditation, exercise specific meditation, and daily homework (13, 21). During this period, the control group did not receive any psychological interventions and only participated in the pretest, posttest, and follow-up stages. All procedures were approved by the Ethics and Research Committee of Yazd University, IR.YAZD.REC1398.039.

### 3.1. Research Instruments

#### 3.1.1. Salivary Cortisol Kit

Measurement of cortisol has been used as a stress marker in research and is a simple, non-invasive, stress-free method for measuring HPA axis activity and a classic and valid biological indicator for measuring tension levels in stressful situations (1, 26, 27). In this study, the cortisol hormone was measured by cortisol kit with a sensitivity of 0.05  $\mu\text{g/dl}$  by ELISA.

The athletes' saliva samples were evaluated four times [15 minutes before the first and second official matches (pretest and posttest), 15 minutes before the third official match (follow-up, three months after the posttest) and once at resting state (one week after the first match)]. To measure cortisol, athletes were asked to wash their mouths with half a glass of cold water before the official match, and after holding saliva for one to two minutes in the mouth, about 2-3 ml of unstimulated saliva was transferred into the test specimen's tube. At all stages of the experiment, the collected saliva samples were rapidly frozen and transferred to the laboratory as soon as possible. Because the cortisol secretion follows the circadian rhythm, the sampling time was the same at all stages. All salivary samples were also tested under the same environmental conditions (place and tester) (1).

#### 3.1.2. Emotion Regulation Questionnaire

The Emotion Regulation Questionnaire was developed by Gross and Jones (2003) with 10 questions, including two strategies of reappraisal (six questions) and suppression (four questions) scored based on a 7-point Likert scale from strongly disagree 1 to strongly agree 7. The reliability of the questionnaire in samples of athletes abroad (8, 9) and our country (28) has been confirmed.

In order to collect the questionnaire data, the researchers then, in coordination with the trainers and supervisors of the teams participating in the competition, proposed the purpose of the research and the necessity of honest cooperation of the subjects in completing the questionnaires. The emotion regulation questionnaire was distributed among athletes and after completion, it was collected before the start of the competition.

## 4. Results

In this study, descriptive statistics were used to classify the data and to present as mean and standard deviation, and inferential statistics were used for data analysis. The Shapiro-Wilk test was used to check the normality of the data distribution. The results showed that the variables of the study were normal ( $P$  value  $> 0.05$ ). Besides, the resting scores of the two groups were compared using an independent sample t-test, which showed no significant difference between the two groups (Table 1).

To evaluate changes in the cortisol levels in four stages (resting to follow-up phases) and to compare the two groups in these stages, the mixed analysis of variance with  $2 \times 4$  design (group  $\times$  time) was used. Taking into account the assumptions of this test, the results are presented in Table 2.

Given the significance of the test results for within-group effects, repeated measures analysis of variance was used to investigate changes in different periods. The results of pairwise comparisons with Bonferroni correction showed that there was a significant difference between the resting stage and other stages in the control group ( $P$  value  $< 0.05$ ). However, there was no significant difference between the other stages ( $P$  value  $> 0.05$ ).

In the experimental group, the results showed a significant difference between the resting stage and other stages as well as between the pretest and posttest ( $P$  value  $< 0.05$ ). However, the difference between the posttest and follow-up was not significant ( $P$  value  $> 0.05$ ). The results are presented in Figure 1.

Also, considering the significance of the mixed analysis of variance results on between-group effects, pairwise comparison results (with the Bonferroni correction) were checked to determine the difference between the two groups at each stage. The results showed that there was a significant difference between the two groups in the posttest and follow-up stages in the experimental group ( $P$  value  $< 0.05$ ). However, there was no significant difference between the two groups in the rest and pretest stages. The results are presented in Figure 2.

Data on the suppression and reappraisal components of emotion regulation in the two groups were also analyzed at different stages using the mixed analysis of variance with  $2 \times 3$  design (group  $\times$  time). The results of the suppression component showed that the main effect of time ( $P$  value = 0.0001) and time in the group ( $P$  value = 0.0001) and group ( $P$  value = 0.0001) was significant.

Given the significance of the main effect of time, repeated measures analysis of variance was used to investigate the place of differences in different stages. Results showed that there was a significant difference between

**Table 1.** Results of Independent Sample t-test to Compare Baseline Scores in the two Groups

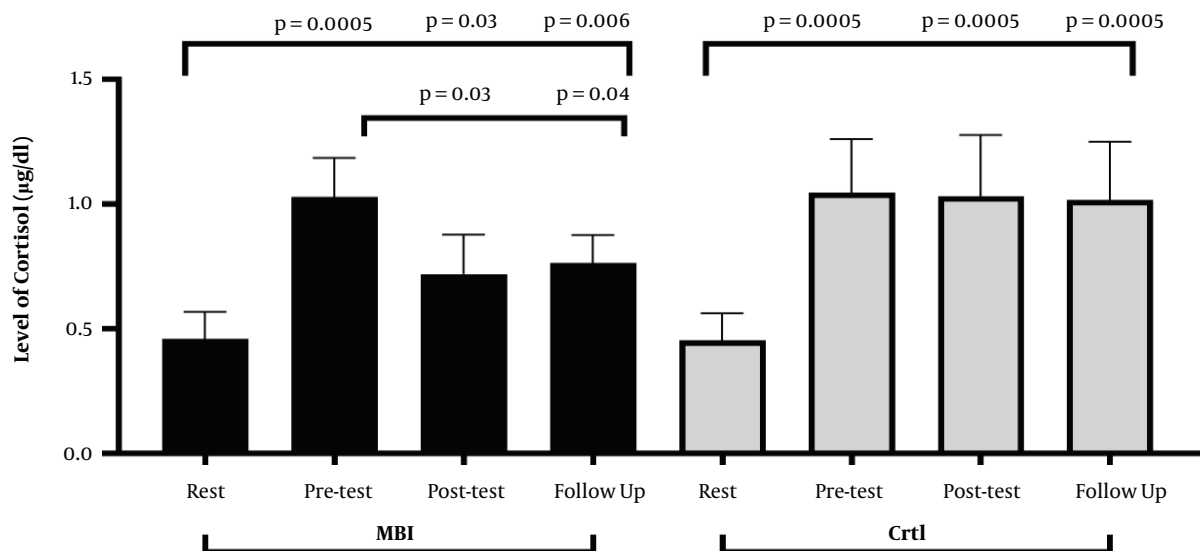
Variable	Mean ± SD	t	df	P Value
<b>Cortisol Level</b>		0.11	18	0.9
Control group	0.45 ± 0.11			
MBI group	0.46 ± 0.10			
<b>Suppression</b>		1.4	18	0.1
Control group	22.30 ± 1.15			
MBI group	21.40 ± 1.64			
<b>Reappraisal</b>		0.6	18	0.5
Control group	22.10 ± 1			
MBI group	22.4 ± 1.17			

Abbreviations: SD, standard deviation; df, degree of freedom; MBI, mindfulness-based intervention.

**Table 2.** Results of Mixed Analysis of Variance Test to Compare within-Group and Between-Group

Indicators Source of Changes	SS	df	MS	F	P Value	$\eta^2$
<b>Time</b>	3.25	1.7	1.9	60.6	0.000	0.7
<b>Group (time)</b>	0.6	1.74	0.35	11.3	0.000	0.38
<b>Error (time)</b>	0.96	31	0.03	-	-	-
<b>Group</b>	24	1	24	9.15	0.007	0.33
<b>Error (group)</b>	0.46	18	0.026	-	-	-

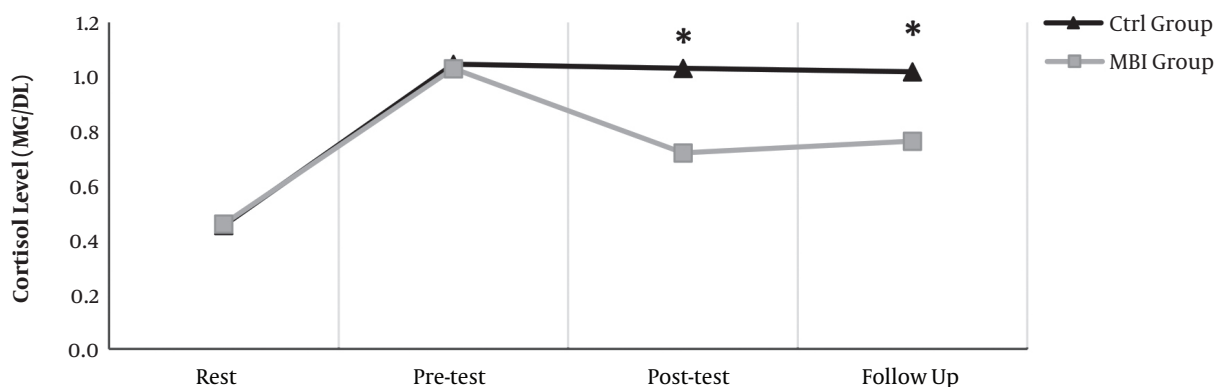
Abbreviations: SS, sum of squares; df, Degree of freedom; MS, Mean squares;  $\eta^2$ , Eta-squared.



**Figure 1.** Results of Changes in Cortisol Levels at Different Stages in the Control and Experimental Groups. Ctrl, control group; MBI, Mindfulness-Based Intervention group. Data are presented as means ± standard error of the mean. P values of less than 0.05 were considered significant.

the pretest and posttest stages in the experimental group (P value = 0.0001). However, the difference between the posttest and follow-up was not significant (P value = 0.08).

In the control group, no significant difference was observed in the suppression component between the stages (P value > 0.05).



**Figure 2.** Results of Comparison of Cortisol Level Changes at Different Stages in the Control and Experimental Groups. Ctrl, control group; MBI, Mindfulness-Based Intervention group. \*indicates a significant difference at ( $P$  value < 0.05).

Given the significance of the main effect of the group in the suppression component, an independent sample  $t$ -test was used to determine the difference between the two groups at each stage. The results showed that there was no significant difference between the two control and experimental groups in the pretest ( $P$  value = 0.1). However, there was a significant difference between the two groups in the posttest and follow-up stages ( $P$  value = 0.0001). The results of the reappraisal component also indicated the significance of the main effect of time ( $P$  value = 0.0001), time in the group ( $P$  value = 0.0001), and group ( $P$  value = 0.0001). Here, because of the significance of the main effect of time, repeated measures analysis of variance was used to determine the difference in place. The results of the experimental group showed a significant difference between the pretest, posttest, and follow-up ( $P$  value = 0.0001). However, there was no significant difference between the posttest and follow-up ( $P$  value = 0.3). There was no significant difference between the two stages in the control group ( $P$  value > 0.05).

Given the significance of the main effect of the group in the reappraisal component, an independent sample  $t$ -test was used to determine the difference between the two groups in the different stages of the study. The results showed that there was no significant difference between the control and MBI groups in the pretest stage ( $P$  value = 0.1). However, there was a significant difference between the two groups in the posttest and follow-up stages ( $P$  value = 0.0001).

## 5. Discussion

The purpose of this study was to investigate the effectiveness of the mindfulness-based intervention on cog-

nitive emotion regulation strategies and salivary cortisol levels on male students' endurance runners with a three-month follow-up. The results showed a significant difference in the suppression and reappraisal components between the control and experimental groups in the posttest and follow-up stages.

To explain the findings, it should be noted that mindfulness-based cognitive therapy has been conceptualized as a basic plan for the treatment of cognitive, behavioral, and emotional problems that focuses primarily on improving emotional self-regulation (29).

Little research has been done on the effect of a mindfulness intervention on cognitive emotion regulation in sport. The results are consistent with the findings of Rocky and Naderi (2018) and Josefsson et al. (2019). These findings can be explained by the fact that the mindfulness, which is based on the acceptance of unpleasant thoughts and different emotional states, greatly enhances one's ability to control the influence of one's thoughts and emotions and allows one to experience a wide range of thoughts and emotions in mind without experiencing emotional disturbance.

Concerning the attained results, given that reappraisal is considered a consistent strategy and suppression of an inconsistent strategy in emotion regulation, it can be stated that individuals will better understand their stressful situations using reappraisal strategy. As a result, they are more easily adapted to unpleasant events because, in addition to reducing negative emotions, they experience positive emotions without spending any physiological, emotional, or social value that can lead to increased ways of thinking, and, in turn, it may provide a situation that distracts attention from threatening and stressful sources. Conversely, chronic attempts to suppress emo-



tions may increase the frequency and severity of negative emotional experiences and prevent triggering and development of emotional impulses, adaptation, and effective coping responses (11), since individuals are always monitoring their behavior to modify their behavioral manifestations at the time of emotion, and this process requires a great deal of energy that can reduce cognitive resources (12) and increase employing ineffective emotion regulation strategies such as suppression and rumination after confronting an emotional event (30). Therefore, it seems that applying a reappraisal strategy will lead to better performance rather than suppression as a result of improving cognitive and emotional performance (11).

In the present study, the reappraisal component associated with decreasing negative emotions increased, whereas the suppression component associated with negative emotions decreased in the posttest stage and this decrease was maintained until the follow-up stage.

Also, the results showed salivary cortisol levels decreased at the posttest stage and maintained until follow-up in the experimental group. Researchers agree that, apart from the effects of physical activity, competition-related psychological arousal also affects the HPA axis and increases cortisol production and secretion (1). Since the research subjects had no physical activity before the match and were not physically stressed, a significant increase in the cortisol before the match compared to the resting state could be attributed to the psychological stress of the match, and its decrease after the intervention could be due to psychological intervention. Also, in explaining these findings and considering the findings of the studies consistent with the present study, it may be suggested that mindfulness training has been effective in reducing negative physiological responses to competitive stress; in other words, mindfulness intervention may have been able to prevent negative thoughts and emotions such as anxiety and stress, and to balance the HPA axis, thereby preventing excess cortisol secretion. Nonetheless, the results are not in line with Baltzel and Akhtar's (2014) research. Some scholars believe that the resulting differences among the research studies may be due to the nature of the intervention, type of program used, location and duration of the program, and so on (31). An important point in the intervention program of the present study was the use of daily homework, which may have impacted the effectiveness of the program, whereas most previous studies were lacking homework.

The results of the present study should be interpreted with some caution owing to several limitations. Measure the gene expression levels of cortisol was one of the research limitations of the present study, so it is recommended that future studies measure the gene expression

levels of cortisol by real-time PCR method as well as to measure the protein levels of cortisol by western blotting method to confirm the results of the present study. Another limitation of the research was not investigating the effect of pre-competition stress and emotion regulation strategies on athletic performance.

Since the present study was performed only on beginner male runners, the results obtained from our study may not be generalized to all athletes. Thus, studies, including athletes from other sports and athletes on different competitive levels, may demonstrate to what extent the present findings can be generalized.

Finally, conducting studies comparing MBI's effectiveness with the efficacy of other psychological interventions and brain stimulation techniques is highly warranted. Also, we recommend that subsequent studies could be conducted with more groups such as practice group, control group, practice and psychological training group, and psychological training group.

In conclusion, the findings showed that a six-week mindfulness-based intervention reduced salivary cortisol concentration and suppression component, while increased the reappraisal component of emotion regulation in beginner endurance runners. The findings suggest that MBI can be used as a new promising method on cognitive emotion regulation strategies and salivary cortisol levels in endurance runners.

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## Footnotes

**Authors' Contribution:** Hossein Samadi: Study concept and design, implementation of the intervention, Setting introduction and discussion and endorsed the final manuscript for submission to the journal; Mohammad Sobhbatia: data collection and analysis and interpretation of data; Behnam Maleki: Setting introduction and discussion.

**Conflict of Interests:** None declared by the authors.

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**Informed Consent:** Informed consent was signed by all participants.

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