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Research Article

Effect of Yoga-Based Mindfulness Intervention on Blood Cortisol Hormone and Competitive State Anxiety in Boy-Skilled Volleyball Players

Maryam Abdoshahi[1], Mahsa Naghizadeh[2], Afsaneh Shemshaki[3]

1- Assistant Professor, Department of Motor Behavior, Faculty of Sport Sciences, Alzahra University, Tehran, Iran.
2- M.A. Graduate of Motor Behavior, Department of Motor Behavior, Faculty of Sport Sciences, Alzahra University, Tehran, Iran.
3- Associate Professor, Department of Exercise Physiology, Faculty of Sport Sciences, Alzahra University, Tehran, Iran.

Article Info

Corresponding Author:
Maryam Abdoshahi

Email:
M.abdoshahi@alzahra.ac.ir

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Abstract

Aim: Mental health is affected by stress and anxiety. Studies have shown that Yoga-based mindfulness interventions reduce anxiety and improve the performance of athletes. The present study aimed to investigate the effect of Yoga-based mindfulness on skilled Volleyball players' blood cortisol hormone levels and competitive state anxiety.

Methods: The participants consisted of 28 boy Volleyball players that randomly divided into experimental (M age = 17.71 ±0.91 y, M experience = 4.64 ± 0.84 y) and control (M age = 17.93 ±0.61 y, M experience = 4.71 ± 1.13 y) groups. Subjects completed the Competitive State Anxiety Inventory (CSAI-R2), and blood samples were also taken to measure cortisol hormone in the pre and post-test phase 30 minutes before a Volleyball match. The experimental group then participated in a Yoga-based mindfulness intervention for 12 sessions (each session 1.5 hours).

Results: The covariance analysis showed that Yoga-based mindfulness exercises caused significantly lower blood cortisol levels ($p = 0.01$), cognitive anxiety ($p = 0.003$), and somatic anxiety ($p=0.0001$) in the experimental group than the control group in the post-test. However, it did not significantly affect self-confidence ($p=0.69$) ($p <0.05$).

Conclusion: The present study suggested that sports psychologists and coaches can use Yoga-Based mindfulness intervention to improve cortisol levels and cognitive and somatic anxiety.

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1. Introduction

Mental health is affected by stress and anxiety. Studies have shown that yoga-based mindfulness interventions reduce anxiety and improve the performance of athletes. Research has shown that many athletes experience state anxiety during training, before and during competition. State anxiety is an immediate and negative emotional state accompanied by fear, anxiety, stress, and physical arousal. Researchers have shown that in addition to experiencing negative thoughts and understanding physiological symptoms, a person's confidence in coping with challenges is also important in creating a state of anxiety (Cheng & Hardy, 2016). State anxiety includes cognitive state anxiety and somatic state anxiety. Somatic anxiety is associated with physiological symptoms (increased heart rate, blood pressure, and body temperature) and biochemistry (cortisol secretion). Competitive state anxiety also means the motivation to avoid failure in the sports environment or worry about failure, which is temporary and arises from participating in a particular sporting competition. If anxiety symptoms occur for a long time, irrationally and severely, they can devastate the psyche and function (Hein et al., 2021). Therefore, one of the factors indicating stress (psychological pressure) and physical anxiety in athletes is the amount of cortisol hormone secretion (in blood and saliva, they are not different from each other). Cortisol is a stress hormone and is a physiological response to acute stress. Some researchers have found that athletes produce the highest cortisol levels before a competition. The secreted cortisol enters the brain's cells and increases their anxiety (Schmidt & Gnam, 2020). Studies have shown that anxiety as a complex emotion has several physiological relationships, including changes in stress hormone levels, autonomic system activity, and its effects on the cardiovascular system (Fan et al., 2018). Some researchers examined the correlation between salivary cortisol concentration and the Competitive State Anxiety Inventory-2 (CSAI-2) response in judo athletes and found that cortisol concentration in winning athletes was more predictive than in losing athletes (Papacosta et al., 2016). Regarding the relationship between physiological arousal, anxiety, and performance, a study on 19 athletes showed that pre-competition cortisol levels increased significantly compared to measurements 24 hours earlier. Athletes' performance was negatively correlated with increasing cortisol concentration 24 hours before the race and caused poor performance (Siart et al., 2017).

Therefore, many studies have recently sought useful psychological intervention methods to eliminate or reduce the factors affecting the production of physical and cognitive anxiety and increase self-confidence in athletes (Weinberg & Gould, 2018). In this regard, various mindfulness-based interventions are known as effective methods. Mindfulness is a special mental quality in which people pay close attention to the experiences that are taking place (Reina & Kudesia, 2020). Mindfulness is a non-judgmental, present-day awareness of an experience that falls within one's focus at a particular moment (Potek, 2012). Extensive research in various communities has confirmed the usefulness of mindfulness on stress (Lengacher, 2012) and anxiety reduction (Strohmaier, 2020; Chen et al., 2019). Therefore, many mindfulness-based interventions and therapies have emerged in recent decades, including mindfulness-based stress reduction (MBSR, Choe et al., 2020; Gawrysiak et al., 2018) and mindfulness-based cognitive therapy (MBCT, Farb et al., 2018), which emphasize sitting, walking meditation, and some yoga exercises.

Research has shown that athletes can also increase their performance by practicing mindfulness by accepting experiences and ignoring non-performance issues. Therefore,

mindfulness-based approaches such as mindful sport-performance enhancement (MSPE, Kaufman et al., 2009) to improve athletic performance have tried to increase athletes' skills and performance. For example, a review article of 52 studies reported a high correlation between mindfulness and the flow experience of performance in athletes (Schneider et al., 2019). In this regard, another study showed that mindfulness and acceptance-based intervention improved competitive performance (Birrer et al., 2012). Another study showed that a five-week intervention based on mindfulness and yoga resulted in increased mindfulness, goal-oriented energy, and less perceived stress in athletes (Perry et al., 2017). Research has also shown that eight weeks of yoga-mindfulness intervention was associated with increased physical self-concept (fitness and health), intrinsic motivation for exercise, and mindfulness (Cox et al., 2016). Other researchers have found that the combined intervention of aerobic running with yoga-based mindfulness increased the ability to regulate emotions, mindfulness, and aerobic fitness (Zhang et al., 2019). Researchers have found that yoga exercises promoting mindfulness reduce stress hormones and anxiety, regulate cholesterol, testosterone, and blood sugar levels, and improve physiological and psychological function (La Torre et al., 2020). In another study, researchers reported that brain alpha waves increased and blood cortisol levels decreased after yoga exercises (Kamei et al., 2000). In addition, research has shown that six weeks of mindfulness training can effectively reduce salivary cortisol levels, reduce pre-match stress, and increase shooters' performance (Samadi et al., 2016). In the same vein, researchers have shown that 12 weeks of Hatta-Yoga practice reduced cortisol and anxiety in women with type 2 diabetes (Nazary Gilannejad et al., 2017). Also, Khunti et al. (2023) argued that Yoga affects mental health in school-aged children.

2. Objectives

In general, according to a brief review of concepts and research in anxiety, it is concluded that when athletes are under stress and understand the imbalance between environmental demand and the ability to respond, it increases the level of cognitive and somatic anxiety. Consequently, athletes' performance will decline. Therefore, the present study sought to find a way to reduce cognitive and physical anxiety to achieve optimal performance.

The object was to investigate the effect of a Yoga-based mindfulness intervention on physiological anxiety (a syndrome that increases the hormone cortisol) and psychological concerns (one of the symptoms of which is an increase in cognitive and somatic anxiety). For this purpose, the community of skilled Volleyball teenagers, who constitute a large part of the country's athletes, was selected as a research sample. Therefore, the main question of the present study is whether Yoga-based mindfulness interventions can affect the level of blood cortisol hormone secretion and competitive anxiety levels of skilled Volleyball adolescents. It is expected that the findings will be useful in achieving the desired performance of skilled adolescent Volleyball players.

3. Methods

3.1. Sample and Procedure

This study was quasi-experimental with a pretest-posttest design with a control group. The number of samples was obtained using GPower. The research sample consisted of 28 skilled male volleyball players from the Qazvin Volleyball Club (Farhangian Sports Hall).

Participants were selected based on inclusion criteria by purposive sampling and randomly divided into experimental and control groups (14 boys in each group) (La Torre et al., 2020). Inclusion criteria were an age range from 16 to 19 years, having at least four years of professional training in volleyball, no restriction of movement of the shoulder, back, pelvis, knee, and ankle joints, no use of neuroleptics, anticonvulsants, and hypnotics, or chemical or herbal remedies to control anxiety and depression. The participants didn't have a history of attending psychological and yoga-based mindfulness classes. The research conditions were explained to all participants, and participation was voluntary.

3.2. Research Tools

3.2.1. Blood cortisol hormone.

Blood samples were taken between 8 and 8:30 AM from each person who fasted for about 10 to 12 hours to measure the blood cortisol hormone levels of the participants in the pre-test and post-test. After transferring the samples to Hakim Laboratory in Qazvin, the blood serum of the samples was separated in a centrifuge at 4000 rpm and then frozen at minus 20 degrees for biochemical measurements. It was taken out of the freezer during the analysis and reached room temperature. The ELISA method (enzyme-linked) and the ideal kit for future diagnosis of Iran were used. All participants signed a written consent form.

3.2.2. Competitive State Anxiety.

The revised Competitive State Anxiety Inventory (CSAI-2R) was used (Cox et al., 2003). This questionnaire has 17 items and consists of three subscales: somatic anxiety, cognitive anxiety, and self-confidence subscales. It is rated on a 4-point Likert scale, ranging from "never" to "too much." Internal consistency of this inventory has been reported in different studies above 0.70. Its factor structure showed that the internal consistency of all subscales had been reported to be higher than 0.70 in Iran (Mehrsafar et al., 2016).

3.3. Procedure

The level of blood cortisol hormone and the competitive state anxiety of both groups were measured in the pre-test stage. All participants were in the same condition in terms of anxiety, so the blood taken was between 8 and 8:30 AM and then they completed the questionnaire 30 minutes before a Volleyball match. Then, participants of the experimental group performed specific Yoga-based mindfulness exercises for one month (12 sessions, three sessions per week), and each session was about 1.5 hours, from 6 to 7:30 PM. No intervention was performed on the control group during this period. Yoga-based mindfulness exercises (summarized in the appendix) were designed based on previous research (Perry et al., 2017; Cox et al., 2016), and were exercised by a Yoga preceptor. The interventions were done from basic to advanced level in a gym. The blood cortisol and anxiety of both groups were measured in the post-test stage. The participants performed the routine Volleyball exercises during this time. The collected data were analyzed using one-way and multivariate analysis of covariance and version 24 of SPSS software

3.3. Ethical Considerations

All participants signed a written consent form from the ethics committee before they participated in this study. Ethical concerns related to this study were informed consent, confidentiality, withdrawal rights, anonymity, privacy protection, and maintaining the dignity of all the participants.

4. Results

Shapiro-Wilk's test confirmed the normal distribution of data between the two groups. Participants of the experimental group had a mean age of 17.71 ± 0.91 and a mean professional training experience of 4.64 ± 0.84 years, and the control group had a mean age of 17.93 ± 0.61 and a mean professional training experience of 4.71 ±1.13 years. Independent sample t-test showed that there was no significant difference between the mean age (F_{26} = 2.33, t = -0.72, p = 0.47) and professional training experience (F_{26} = 0.94, t = -0.18) of the two groups. The mean and standard deviation of the research variables by experimental and control groups are presented in **Table 1.**

Table 1. Descriptive statistics of variables in the experimental and control groups

Variable	Subscales	Pre-Test		Post-Test	
		Experimental	Control	Experimental	Control
		M±SD	M±SD	M±SD	M±SD
Hormone	Blood Cortisol	26.99±11.76	25.83±10.31	21.57±7.66	29.17±9.53
Competitive Anxiety	Somatic Anxiety	12±3.41	11.64±2.43	9.71±2.26	12.79±2.57
	Cognitive Anxiety	10.29±3.60	13.79±5.98	7.57±2.13	11.29±3.53
	Self Confidence	16.50±2.79	13.93±3.54	15.71±3.19	14.14±3.48

One-way analysis of covariance was used to evaluate the effect of Yoga-based mindfulness on blood cortisol. The non-significance of the Leven test to examine the homogeneity of variance of blood cortisol post-test scores (F = 4.39, df = 26, p≥0.05) indicates that the assumption of variance homogeneity is valid. Also, the regression line slope homogeneity test (F = 2.96, df = 2, sum of squares = 147.42, mean squares =73.71) was not significant. Therefore, the assumption of regression line slope homogeneity (Relationship between pre-test and post-test blood cortisol scores) was accepted.

Table 2. ANCOVA test to compare the effect of Yoga-based mindfulness on the blood cortisol hormone

Variable	Source of Changes	Df	Mean Squares	F	P	μ^2
Blood Cortisol hormone	Pre-Test	1	409.12	6.64	0.16	**0.21**
	Groups	1	449.16	7.29	0.01	**0.22**
	Error	25	61.53	-	-	**-**

Table 2 shows a significant difference between the post-test blood cortisol scores of the experimental and control groups. The effect size for the main effect of the group showed that a total of 22.6% of the blood cortisol variance of skilled volleyball players was due to the yoga-based mindfulness intervention. The LSD post hoc test (least significant difference) showed that the adjusted mean blood cortisol level of the subjects in the experimental group was significantly lower than the control group (p = 0.01). Therefore, it was observed that yoga-based mindfulness significantly reduced the blood cortisol hormone of skilled volleyball players.

Multivariate analysis of covariance was used to investigate the effect of a yoga-based mindfulness intervention on competitive state anxiety. The M-box test was not significant. So, the assumption of the same variance-covariance matrix in competitive post-test anxiety scores

(P > 0.05, Box's M = 6.27, F = 0.91) was established in the groups. Levene test results were not significant and showed that the assumption of homogeneity of variance of post-test scores of competitive state anxiety was established (somatic anxiety: F = 0.78, p = 0.38; cognitive anxiety: F = 0.07, p = 0.78; self-confidence: F = 1.89, p = 0.18). The results of the regression line homogeneity test showed that the interaction effects between the pretest and group scores (experimental and control) were not significant (p > 0.05). Therefore, the hypothesis of homogeneity of regression line slopes was accepted.

Wilkes Lambda test on the effect of a yoga-based mindfulness intervention on competitive state anxiety (P < 0.05, Wilks Lambda = 0.460, F = 8.20) showed that the effect of this intervention was significant. Also, the effect size states that 54% of the total competitive state anxiety variance was due to the yoga-based mindfulness intervention. The multivariate analysis of covariance (**Table 3**) showed that the main effect of the group on somatic and cognitive anxiety between post-test scores was significant.

Table 3. MANCOVA test to compare the effect of a Yoga-based mindfulness intervention on competitive state anxiety

variable	Source of changes	df	mean squares	F	P	μ^2
somatic Anxiety	pre-test	1	55.49	13.75	0.001	0..37
	Groups	1	70.35	17.43	0.001	0.43
	Error	23	4.03	-	-	-
Cognitive Anxiety	pre-test	1	2.47	0.31	0.58	0.01
	Groups	1	88.82	11.35	0.003	0.33
	Error	23	7.82	-	-	-
Self Confidence	pre-test	1	12.90	1.42	0.24	0.05
	Groups	1	1.42	0.15	0.69	0.007
	Error	23	9.06	-	-	-

Then, the results of the LSD post hoc test showed that the mean scores of the subscales of somatic (mean difference = -3.71, p = 0.0001) and cognitive anxiety (mean difference = -4.17, p = 0.003) of the experimental group were significantly lower than the control group (P <0.05). Therefore, it was observed that Yoga-based mindfulness intervention significantly reduced the somatic and cognitive anxiety of skilled Volleyball players but did not significantly affect their self-confidence (mean difference = 0.52, p = 0.69). The difference in the 5% error level was significant.

5. Discussion

The present study aimed to evaluate the effectiveness of yoga-based mindfulness intervention on the blood cortisol hormone and competitive state anxiety of skilled young volleyball players. The results showed that yoga-based mindfulness reduced blood cortisol. Somatic anxiety and cognitive anxiety in the experimental group's post-test. However, there was no significant difference in self-confidence scores between the two groups.

The present study results indicate that the blood cortisol hormone, which is secreted due to stress, has been reduced due to yoga-based mindfulness exercises. In other words, this intervention may have reduced athletes' stress and, as a result, has indirectly reduced one of the physiological symptoms of stress, namely the cortisol hormone. The present study's findings on

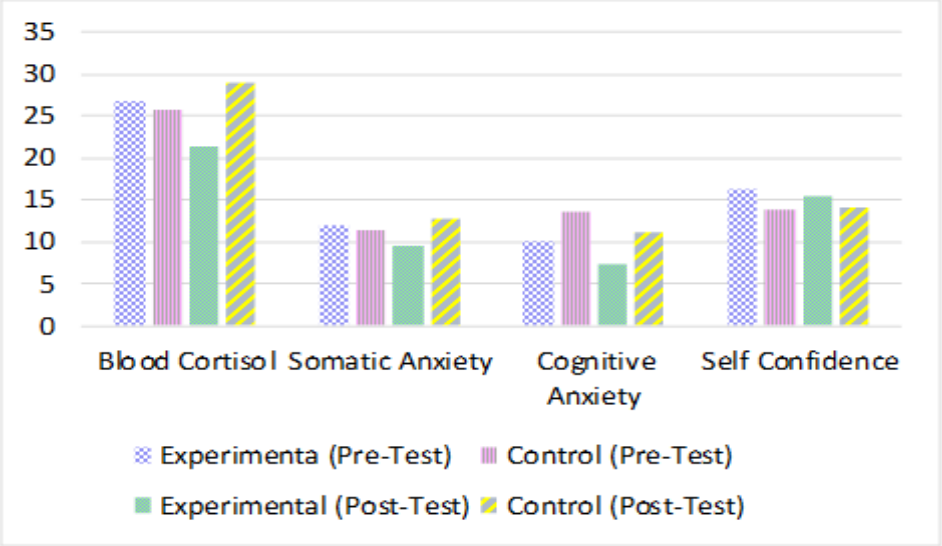


Figure 1: Comparison of study variables between experimental and control groups

reducing blood cortisol levels in the experimental group are consistent with studies showing that various mindfulness-based therapies effectively reduce cortisol levels (Lengacher et al., 2016; Galantino et al., 2005; Brand et al., 2012; Khunti et al., 2023). For example, researchers have found that participating in the mindfulness-based stress reduction (MBSR) course reduced experienced and novice meditators (Brand et al., 2012). On the other hand, in some studies, a decrease in cortisol levels has not been observed due to mindfulness-based interventions. For example, in one study, a three-week course of mindfulness-based intervention did not change cortisol levels (Lipschitz et al., 2012). In addition, the meta-analysis of O'Leary et al. (2016) showed inconsistent findings on the effect of mindfulness-based interventions on cortisol levels. The present study results were not in line with the results of these studies.

Other findings of the present study were the reduction of somatic and cognitive anxiety in the experimental group, which were consistent with studies conducted in this field. For example, researchers have shown the effectiveness of mindfulness training in reducing competitive anxiety in amateur baseball players (Chen et al., 2019). Scott-Hamilton, Schutte & Brown (2016) also found in a study on cyclists that mindfulness-based interventions can effectively reduce anxiety and facilitate the flow of performance. Also, other researchers showed that mindfulness-based intervention and yoga led to a reduction in perceived stress in student-athletes (Perry et al., 2017). In this regard, Zhang et al. (2019) found that the combined intervention of aerobic running with mind-based yoga increased the ability to regulate emotions.

In this regard, other studies have shown the effectiveness of yoga-based mindfulness in reducing anxiety in middle-aged women (Evazei et al., 2019), the effectiveness of mindfulness-based stress reduction programs (MBSR) in reducing overt and covert anxiety in obese women (Jafari et al., 2017) in increasing the mental toughness of athletes with different skill levels (Mir et al., 2022), the effectiveness of mindfulness-based psychotherapy on reducing social anxiety in intervened individuals (Bayrami et al., 2015), and in increasing resilience and anger control (Mir et al., 2023). The results of the present study in the case of the development of anxiety agreed with Khavasi et al. (2023) that affected anxiety components by a treatment program and Shafiabadi et al. (2023) that improved body image and cognitive emotion through mindfulness cognitive therapy. Therefore, it is observed that the present study results are in line with the

findings of previous studies. In explaining the present findings, it can be said that yoga-based mindfulness exercises included breathing exercises, mind control, and relaxation training that led to relaxation and reduced anxiety in athletes (Weinberg & Gould, 2018) and then reduced blood cortisol levels and anxiety in the subjects. In other words, yoga-based mindfulness intervention includes relaxing and stretching exercises; therefore, it has reduced the amount of stress and anxiety and, consequently, the blood cortisol hormone of athletes. It is possible that the participants, as a result of a mindfulness intervention, were able to manage their minds and overcome dysfunctional beliefs that can lead to stress and anxiety (Reina & Kudesia). Also, the mechanisms of mindfulness and yoga help the person achieve a state of mental silence and calmness, turn one's attention to the present moment, and release oneself from unnecessary mental activities. This mechanism develops the ability to accept people without judgment when confronted with disturbing thoughts and emotions. Therefore, it can reduce people's anxiety (Scott- Hamilton et al., 2016) and, at the same time, make them perform better. Athletes may be more anxious depending on their situation, so mindfulness skills will be effective by reinforcing attention in a receptive, purposeful, and timely manner, without judgment or prejudice. Athletes may be more anxious depending on their situation, so mindfulness skills by reinforcing attention in a receptive, purposeful, timely manner without judgment and prejudice.

Athletes according to their position may be faced with more anxiety. so, mindfulness skills by reinforcing attention in a receptive manner targeted at the present moment without judgment and prejudice, will effectively reduce their stress (Chen et al., 2019). In this context, it has been shown that mindfulness emphasizes sitting exercises, walking meditation, and some Yoga exercises that will increase muscle relaxation and reduce fear, stress, and anxiety (Choe et al., 2020). In addition, frequent focusing on a neutral stimulus (such as focusing on breathing) will reduce anxiety symptoms by providing physical and mental relaxation (Evazei et al., 2019). In the present study, a Yoga-based mindfulness intervention did not affect the self-confidence of the experimental group. Because mindfulness training emphasizes concentration, meditation, and relaxation techniques, they have little effect on self-confidence. These types of basic psychological skills probably require other interventions. For example, maybe people need to improve such basic skills with cognitive-behavioral approaches.

6. Limitation and Recommendation

The present study was associated with limitations. For example, the researcher was not aware of the necessary motivation to complete the questionnaires and had no control over mental problems that increase blood cortisol levels. Lack of control over nutrition and mental problems can cause decreased self-confidence and anxiety. Also, this study was performed only on 16- to 19-year-old boy volleyball players, so care should be taken to extend the results to other groups. Additionally, the lack of a follow-up period in the present study prevented longitudinal changes due to the passage of time after the intervention period. It is suggested that future studies be conducted on female volleyball players and athletes in other sports at different age groups, skill levels, and other psychological variables.

7. Conclusion

The present study showed that the blood cortisol hormone (a physiological symptom of stress) and somatic and cognitive anxiety (competitive anxiety subscales) are reduced by yoga-based mindfulness intervention, but self-confidence was not affected. According to the present study, it

is suggested that yoga-based mindfulness techniques can be useful in reducing blood cortisol hormone and somatic and cognitive anxiety in athletes. This finding is also very important and practical for sports psychologists to improve the psychological skills of athletes.

8. Author Contributions

In the present study; all authors participated in the process of design, data collection and analysis, and interpretation of the results. Also, All authors have drafted the manuscript and read and approved the manuscript.

9. Acknowledgment

The authors wish to thank the coaches and athletes for helping and participating in this research.

10. Conflicts of Interest

There are no conflicts of interest.

11. Ethical Approval

This research was approved by the Research Ethics Committee of the Sport Sciences Research Institute and was approved according to compliance with Ethical Standards in Research of the Ministry of Science, Research and Technology, with the code IR.SSRI.REC.1401.1432.

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Appendix: A summary of Yoga-based mindfulness training sessions.

sessions	trains
Session 1	They are introducing the abilities of the mind. Overview of Yoga - mindfulness training and Yoga. Mindfulness breathing training. Body scan and attention to breathing.
Session 2	Freeing the body and mind from daily affairs and training the conscious mind. Breathing technique. Body scan and conscious mind attention to breathing.
Session 3	Relaxation of body and mind. Teaching the concepts of emotions. Body senses and thoughts. Breathing technique and body scan.
Session 4	Physical observation and exercise of the mind meditation. Consciously stepping and experiencing the movement of the body.
Session 5	Release and body scan. Focus on hearing. Training to hear the conscious mind (receptive sounds). Respiratory observation.
Session 6	Training to guide awareness of the body and the world outside of it using back-and-forth exercises. Focusing attention on the sense of hearing consciously (expressive sounds) - Scanning the body and consciously breathing.
Session 7	Performing sitting meditation practice with conscious mind breathing. Consciously focusing attention on the sense of sight. Observing practice.
Session 8	Release and body scan. Mindful observation of respiratory observation. Focus on attention to the sense of hearing. Performing the kindness meditation.
Session 9	Focus on the sense of touch consciously. Consciously breathing and practicing white room meditation (allowing thoughts to bring them to consciousness and observing them instead of fighting).
Session 10	Mind release and body scan. Mindfulness training. Practicing breathing techniques in 3 stages. Respiratory monitoring.
Session 11	Observation practice. Performing memory training in front of observation. Release and body scan.
Session 12	Release and body scan. Review of all trained mindfulness exercises. Seattle breathing technique.