The comparison impact of Metacognitive Therapy-Based Group Intervention and Group Acceptance-Based Behavioral Therapy on Psychophysiological Signs of Professional Soccer Players in the U-19 League in Tehran

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Abstract

The present study aimed to compare the effect of metacognitive therapy-based group intervention and group acceptance-based behavioral therapy on psychophysiological signs of professional soccer players in the U-19 league in Tehran. Participants were professional soccer players occupied in professional soccer leagues in Tehran. The participants were entered into the assessment stage, and after obtaining informed consent, they were randomly assigned to one of the three experiment groups, namely MCT, MAC, and WL. The participants' psychophysiological signs included EEG, EMG, HR, GSR, temperature, and RR, which were recorded using the ewave 8-channel neuro-biofeedback device. The data were analyzed using the eProbe7.8.3 software of Rubymind.us. The results demonstrated that MCT and MAC could make some changes in psychophysiological signs of anxious soccer players. MCT was shown to affect Fz Highbeta-Gama and RR, which had a correlation with anxiety. In addition, MAC was observed to affect the asymmetry of F3 alpha and F4 alpha as a remarkable EEG pattern of aggression. However, MCT and MAC did not show any effect on HR, EMG, temperature, and GSR. According to these findings, it can be inferred that those soccer players who are uncomfortable and suffer from anxiety and aggression-related problems may benefit from such interventions.

Keywords: Metacognitive Therapy, Acceptance Based-Behavioral Therapy, Psychophysiological Signs, Professional Soccer Players

1. Background

Emotions are regarded as a multidimensional phenomenon. They exist as subjective, physiological, purposive, and social phenomena (1). Athletes, like other humans, are affected by stressful situations such as competition. Numerous athlete-generated bodily descriptors are examples of physiological components of emotions. These abnormal physical characteristics experienced in different locations include legs/feet, arms/hands, neck/shoulders, face, stomach (2), the heart rate (HR), changing in the respiratory rate and depth, skin temperature, GSR, and EEG patterns.

Since the introduction of the multidimensional theory of anxiety (3), competitive state anxiety, primarily hypothesized based on cognitive anxiety, has proven to have a negative correlation with athletic function. Moreover, confidence has been demonstrated to have a direct positive correlation with athletic function, and affects act as a protective element in contrast with cognitive anxiety. In addition, somatic anxiety has been shown to have a curvilinear correlation with athletic function and performance (4).

In the contemporary world, psychophysiology is a usable procedure in sport and exercise psychology. Cognitive approach specialists have revealed that stimulating the brain can produce a strong feeling and emotion, neither this nor any other non-cognitive variable plays an important role in activating emotion. For instance, Frijda debated "neurophysiological mechanisms involved in emotional phenomena" as "states for emotion" rather than as a neural system capable of independently activating emotions (5).

EEG is an electrophysiological measurement technique that captures the cortical activity of the brain (6).

The correlation of emotions with EEG among human subjects has been illustrated about three decades ago. Particularly, the phenomenon of "frontal EEG asymmetry" has contributed to emotion studies (7). Based on this point of view, trait frontal asymmetries have been most commonly associated with other characteristics, such as sociability, behavioral activation, and aggression (8). If right frontal Alpha at F4 site in the 10 - 20 system is greater than left frontal Alpha at F3 site, it is probably a marker for oppositional, defiant, and socially aggressive or socially indifferent behavior (9). More anxious individuals exhibit higher right frontal activity and more respond to negative emotions. In addition, people with higher left frontal activity reveal a higher level of positive emotions (7). A moderate altitude in the Highbeta-Gamma/Beta proportion on Fz declares upraised activity of the anterior cingulate (AC) (9). Some other researchers have highlighted how the evidence points to social and emotional information being processed in a specific anterior cingulate cortex sub-region in the gyrus (10).

Based on emerging empirical findings, the theoretical foundations of the third-wave movement take a dissimilar outlook on the connection between cognitions, emotions, and behavior (11). During the past couple of decades, there has been a dramatic increase in the theory development, scientific research, and practice of psychological interventions, often known as acceptance-based behavioral therapy (ABBT) (12).

Specifically in the context of sport and exercise psychology (13), the mindfulness acceptance commitment (MAC) approach, introduced in 2001 and developed by Gardner and Moore (11), to enhance performance is an acceptance-based intervention purposed to promote high-level competitive performance and overall psychological well-being. The MAC approach to amplify performance integrated and adapted the acceptance and commitment therapy (13, 14) and mindfulness-based cognitive therapy (15) to use in athletic populations (11, 16-19).

On the other hand, metacognitive therapy (MCT) is based on the principle that metacognition is vitally essential in understanding how cognition works and produces conscious experiences that we have of ourselves and the world around us (20). In sport and exercise psychology, metacognition refers to the regulation of thinking of athletes during sport settings (21). The foundation of MCT is based on an information processing model of indicators involved in the etiology of mental disorders and maintenance of them. This model, called the self-regulatory executive function (S-REF) model, was originally presented by Wells and Matthews (1994) and has been subsequently elaborated (20, 22, 23).

2. Objectives

The present study aimed to compare the impact of MCT-based group intervention and group MAC as ABBT on psychophysiological signs of professional soccer players in Tehran, Iran.

3. Methods

The present quasi-experimental study was designed in three phases, including pretest, posttest, and three-month follow-up. Participants were professional soccer players engaged in professional soccer leagues in Tehran.

The participants were selected based on 2 standard deviations above the mean of the players in the Persian version of the revised competitive state anxiety inventory-2 (rCSAI-2), a score above 15 in the subscale of cognitive anxiety, and a score above 12 in the subscale of anxiety. The participants were entered into the assessment stage, and after obtaining informed consent, they were entered into the randomization phase. Afterward, they were randomly assigned to one of the two experiment groups receiving MCT and MAC and also to the waiting list control group.

The study population included all professional soccer players participating in the U-19 league in Tehran in the year 2017 - 18.

The samples were collected using judgmental (purposing) sampling. The inclusion criteria included being employed in one of the soccer teams in the Tehran provincial league, having a minimum 9 grade high school, obtaining a score higher than 15 in the subscale of cognitive anxiety and above 12 in the scale of somatic anxiety in the Persian version of rCSAI-2, and being right-handed. The exclusion criteria were simultaneously gaining any psychiatric and/or psychological treatments and having a chronic mental disorder (substance abuse, schizophrenia spectrum disorders, and other psychotic disorders; neurodevelopmental disorders). Moreover, more than one session absence was determined as a dropout criterion.

The number of sessions for both MCT and MAC was seven (two sessions per week, for a total of four weeks), and the duration of each session was 90 minutes. At the end of the interventions, the participants were assessed with neurophysiological devices. Eventually, three months after the posttest, final assessments were carried out.

3.1. Procedures and Assessments

Psychophysiological signs included EEG, EMG of frontalis (forehead) muscle, HR, GSR, the temperature of finger of hand, and RR, which were obtained using the ewave 8-channel neuro-biofeedback device with 1000

sample rates per second. The data were analyzed in the eProbe7.8.3 software of Rubymind.us.

It is noticeable that the EEG assessment was recorded using three channels (F3, Fz, and F4) with electrodes according to the international 10/20 system. Data collected with left ear attached reference electrode and right ear attached ground electrode.

3.2. Randomization and Masking

The participants were randomly assigned to one of the three groups using a random number generator in Microsoft Office Excel. Moreover, randomization was stratified using rCASI-2.

3.3. Therapist

One certified clinical psychologist with 10 years of experience as a clinician and sport psychologist, who received extensive training in both MCT and ACT from national and international leading experts, was selected for the trial.

3.4. Treatments

The MCT plan for anxiety (20) was the main resource for MCT-based intervention in the present study. This was intended as a guide for the treatment of the structure and content and should be applied flexibly as required by individual circumstances (20).

The first session: Introduction of the metacognitive model, as well as competitive anxiety, anger, and sports aggression,

The second session: Socialization to the metacognitive model,

The third session: Verbal and behavioral reattribution; uncontrollability of worry and anger,

The fourth session: Challenging beliefs about the danger of worry and anger

The fifth session: Challenges with positive metacognitive beliefs on the risk of worry and anger,

The sixth session: Working on a new plan for worry and anger,

The seventh session: Relapse prevention.

The MAC manual (11) is a semi-structured program, which offers several types of techniques to help performers (exercisers and/or players in our case) accept their inner thoughts and emotions as they pay attention to the linked stimuli and tasks in here and now situation for reaching personal meaningful goals and aims (24). The program, therefore, typically takes between seven and 12 sessions (25). The MAC protocol was revised from a fixed eight-session format to a flexible seven-module format, providing the opportunity to deliver any of the modules over any

number of necessary sessions (11, 17). The MAC protocol allows for the effective enhancement of performance and overall mental and generalized well-being among athletes (16).

A short description of the MAC manual (24) is given as follows:

The first session: Psycho-education for group preparation,

The second session: Introduction to cognitive diffusion and mindfulness,

The third session: Introduction to values and value-related behaviors,

The fourth session: Introduction to acceptance,

The fifth session: Commitment improvement,

The sixth session: Skill maintenance and MAC integration,

The seventh session: MAC maintenance and improvement.

4. Results

Table 1 illustrates the demographic information of the samples. There were no significant differences among the samples in terms of age (P = 0.23), cognitive competition state anxiety (P = 0.47), somatic competition state anxiety (P = 0.49), and position (P = 0.78).

The findings of repeated measure ANOVA from the pretest, the posttest, and the follow-up are illustrated in Table 2.

The results showed that there was a significant difference among the samples in terms of Fz Highbeta-Gama (f = 4.01, P < 0.05; η^2 = 0.12). The post-hoc Scheffe's method of multiple comparison showed that MCT was more effective than the control group waiting list; however, there were no differences between MAC with MCT and the control group waiting list in terms of Fz Highbeta-Gama. The results also showed that there were significant differences among the samples in terms of F3/F4 alpha (f = 3.46, P < 0.04; η^2 = 0.11). The post-hoc Scheffe's method of multiple comparison also revealed that MAC was more effective than the control group waiting list, although there were no differences between MCT with MAC and the control group waiting list in terms of Fz Highbeta-Gama.

The results also demonstrated that there were significant differences among the samples in terms of RR (f = 3.48, P < 0.04; η^2 = 0.11). The post-hoc Scheffe's method of multiple comparison showed that MCT was more effective than the control group waiting list; however, there were no differences between MAC with MCT and the control group waiting list in terms of RR.

Further, the results indicated that there were no significant differences among the samples in terms of the heart

Table 1. The Demographic Information of the Groups

Characteristic	MCT	MAC	W-L	Total	F/χ^2	P
Age mean (SD)	18.25 (0.75)	18.15 (0.74)	17.85 (0.81)	18.08 (0.77)	1.504	0.231
CSAI2-cog mean (SD)	23.45 (5.44)	21.85 (4.61)	23.50 (4.35)	22.93 (0.00)	0.757	0.474
CSAI2-som mean (SD)	17.60 (4.99)	17.50 (4.41)	16.15 (3.30)	17.08 (4.27)	0.713	0.494
Position	-	-	-	-	0.485	0.785

Table 2. The Results of Repeated Measure and Pairwise Comparisons

Measure	Phase	W-L, Mean (SD)	MCT, Mean (SD)	MAC, Mean (SD)	F	P	Pairwise Comparisons (p)		
							MCT vs. MAC	MCT vs. W-L	MAC vs. W-L
EEG 1	P	0.60 (0.16)	0.59 (0.14)	0.59 (0.17)	0.03	0.97	0.99	0.97	0.98
	PT	0.60 (0.18)	0.42 (0.04)	0.50 (0.15)	-	-	-	-	-
	FU	0.60 (0.18)	0.43 (0.05)	0.49 (0.15)	4.01	0.02	0.51	0.02	0.26
EEG 2	P	15.21 (11.23)	14.03 (14.23)	12.35 (11.66)	1.80	0.18	0.54	0.18	0.74
	PT	14.49 (10.94)	9.38 (11.25)	-0.16 (11.90)	-	-	-	-	-
	FU	10.82 (13.65)	8.02 (12.02)	2.20 (11.56)	3.46	0.04	0.25	0.067	0.04
HR	P	61.97 (7.93)	66.69 (6.42)	66.56 (7.98)	2.58	0.08	0.99	0.15	0.16
	PT	62.78 (9.03)	57.08 (6.48)	54.30 (7.04)	-	-	-	-	-
	FU	62.82 (10.96)	53.15 (7.95)	53.96 (9.31)	1.83	0.17	0.96	0.34	0.21
EMG	P	2.68 (1.12)	2.57 (1.38)	2.49 (1.36)	0.10	0.90	0.98	0.91	0.97
	PT	2.72 (1.13)	2.26 (1.30)	2.14 (1.25)	-	-	-	-	-
	FU	2.53 (1.09)	2.15 (1.18)	2.12 (1.14)	0.60	0.55	0.98	0.71	0.59
Resp	P	11.61 (1.52)	12.23 (1.62)	12.45 (1.45)	1.65	0.20	0.90	0.44	0.22
	PT	11.40 (1.56)	7.47 (0.95)	8.84 (1.31)	-	-	-	-	-
	FU	11.61 (1.73)	7.41 (0.96)	8.90 (1.38)	3.37	0.05	0.26	0.05	0.67
Temp	P	32.24 (1.66)	32.74 (1.90)	32.44 (1.67)	0.41	0.67	0.86	0.67	0.94
	PT	32.02 (2.15)	32.64 (2.18)	32.53 (1.88)	-	-	-	-	-
	FU	32.09 (1.18)	32.86 (2.45)	32.92 (1219)	0.58	0.56	0.98	0.60	0.71
GSR	P	264.94 (88.58)	242.48 (92.23)	249.15 (87.38)	0.33	0.72	0.97	0.73	0.96
	PT	271.02 (99.94)	274.10 (96.06)	293.30 (104.68)	-	-	-	-	-
	FU	254.37 (96.04)	258.50 (99.37)	296.18 (99.48)	0.48	0.62	0.64	0.98	0.77

Abbreviations: EEG1, Fz Highbeta-Gama/Beta; EEG2, F3 Alpha-F4 Alpha/F4 Alpha * 100; EMG, electromyography; FU, three months follow-up; GSR, galvanic skin response; HR, heart rate; P, pretest; PT, posttest

rate (f = 1.83, P < 0.17), EMG of frontalis muscle (f = 0.60, P < 0.55), temperature (f = 0.58, P < 0.56), and GSR (f = 0.48, P < 0.62).

5. Discussion

In conclusion, the present study demonstrated that MCT and MAC could make some changes in psychophysiological signs of anxious soccer players. MCT was observed to affect Fz Highbeta-Gama and the RR rate, which were correlated with anxiety. In addition, MAC was proven to affect the asymmetry of F3 alpha and F4 alpha as a remarkable EEG pattern of aggression. However, MCT and MAC did not have any impact on HR, EMG, temperature, and GSR.

These findings provided support for many studies, highlighting that psychological interventions could make some changes in psychophysiological signs. Accordingly,

in a review article, 17 out of 23 published articles reported significant impacts on the improvement of athletic performances immediately after psychological interventions among athletes in sport settings. Most of these interventions emphasized the reduction of the stress rate (26). Saraladevi (7) considered that cognitive behavior therapy had an effect on the asymmetry of frontal lobe and anxiety rates among students. In another study (27), it was reported that arousal significantly increased after a respiratory-based intervention. Moreover, Davidson et al. demonstrated a positive effect of a mindfulness meditation program on the brain electrical asymmetry (28). Goodman et al. (29) and Gardner and his colleagues reported that MAC approached interventions were effective in reducing emotional symptoms as well as the core beliefs and inner processes of them (30). In another study, Paquette et al. proposed that psychotherapies, such as cognitive behavior therapy, have the

potential to alter abnormal neural systems related to anxiety (31). They illustrated that in a psychotherapeutic setting, the brain of the participants had an ability to "rewire", i.e., the process of rewiring the brain called neuroplasticity. The term neuroplasticity refers to the potential of the human brain to change in reaction to injury and experiencing of normal developmental processes (32, 33). The AC activity can be assessed at Fz site by assessing Highbeta, Beta, and Gamma (9). This part of the brain is engaged in processing emotion and social cognitions (34). Andrews and Jenkins (35) reported that individuals with high resilience to an anxiety disorder showed fMRI profiles had high connectivity between the AC and the amygdala and anterior insula respectively and a high activation of the AC, which is in keeping with inhibition of anxiety; these findings implicitly support recent study findings.

In applied settings, these findings suggest that psychotherapies probably change in the function of AC. Accordingly, EEG modifications were monitored. This would ensure that soccer players suffering from anxious and stress-related problems obtained advantages from these forms of interventions to improve their mental health. In addition, the frontal EEG asymmetry may produce useful markers for anxiety. Unfortunately, at least at the moment, we cannot conclude that MCT and MAC modify arousal and its psychophysiological signs compared to the control group waiting list; however, the existing research provides an empirical investigation of the MCT and MAC approaches, which were developed specifically to target the core processes that underlie mental health and performance issues. It was also revealed that MCT and MAC were effective in reducing EEG signs of anxiety and aggression among professional soccer players.

Finally, it is proposed in future studies that researchers assess changes of the AC function in psychotherapeutic experiments with new high-tech devices including positron emission tomography (PET) scan, functional magnetic resonance imaging (fMRI), plus EEG, and also other electrophysiological devices for examining psychophysiological signs and markers of emotional situations.

Footnotes

Authors' Contribution: S. Mohammad Reza Alavizadeh developed the original idea and the protocol and also abstracted and analyzed data, wrote the manuscript, and is guarantor Nasser Sobhi Gharamaleki, Shahram Mami, Jahanshah Mohammadzadeh, and Vahid Ahmadi contributed to the development of the study concept and design, as well as the study supervision.

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