

A Randomized Controlled Trial on the Efficacy of Positive Psychotherapy on Improving Executive Function and Plasma Cortisol Levels in Patients with Anxiety

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(Received: 10 May 2021; Revised: 19 May 2021; Accepted: 30 May 2021)

Abstract

Interoduction: Anxiety among students can lead to decreased performance and may be associated with other psychological and biological consequences. Therefore, it deserves clinical attention. On the other hand, reinforcing positive resources such as feelings, behaviors, and positive cognitions can be used as an important intervention in managing and improving mood disorders. This study evaluated the efficacy of positive psychotherapy on improving executive function and modulating serum cortisol levels in patients with anxiety.

Method: In a randomized controlled clinical trial, 30 students with anxiety symptoms were selected using purposive sampling method and were assigned to experimental and control groups through block randomization method after confirming entry criteria. The intervention was presented to the experimental group in a positive approach for ten weekly sessions and the control group was placed on the waiting list. Changes in the executive functions index were considered as primary outcomes and serum cortisol levels fluctuations were considered as secondary outcomes. Data were analyzed by multivariate analysis of covariance in SPSS 21 software.

Result: Primary outcomes showed that ten weeks of positive therapy had a significant effect on improvement of executive function ($p < 0.001$). Secondary outcomes also showed that positive psychotherapy was effective in decreasing serum cortisol levels ($p < 0.001$).

Conclusion: Results showed that positive psychotherapy had a significant effect on the improvement of executive function and reducing serum cortisol levels. These findings demonstrate the effectiveness of psychotherapy on the prefrontal cortex (PFC) and its interaction with the hypothalamic–pituitary–adrenal (HPA) axis function.

Declaration of Interest: None.

Declaration of Interest: None

Keywords: Anxiety, Cortisol, Executive functions, Positive therapy, Psychotherapy.

Introduction

Anxiety among students and its direct relationship with mood disorders and its inverse relationship with psychological well-being is considered as the most important challenges of students' lives (1). Evidence indicates a high prevalence of mental health problems, including anxiety and depression among students (1). Anxiety among students can lead to a decline in performance and can be associated with other psychological consequences (2). However, there are few studies for effect of psychological interventions to reduce the student anxiety (3, 4). Sub-syndromal anxiety refers to the existence of major clinical symptoms that these symptoms in terms of intensity are not enough for the diagnosis of anxiety disorder and does not meet all the diagnostic criteria (5). Sub-syndromal anxiety is associated with the experience of anxiety in daily life, although the number and severity of the syndrome do not reach the threshold for the diagnosis of anxiety disorder.

Nowadays, positive approaches have provided a clear perspective to therapists in the field of treatment of psychiatric disorders (6). Positive psychotherapy (PPT), which integrates symptoms with strengths, resources with risks, weaknesses with values, and hopes with, regrets in order to understand inherent complexities of human experiences in a balanced way. Positive psychology is a new branch of psychology. The focus of this field is on personal growth rather than treating illness (7).

PPT systematically amplifies the positive resources; specifically, positive emotions, character strengths, meaningfulness, positive relationships, and intrinsically motivated accomplishments (8). The results of Song et al. (9) Pirnia et al. (8) and Taylor et al. (10) showed that reinforcing positive resources such as feelings, behaviors, and positive cognitions can be used as an important

intervention in the management and improvement of mood disorders. The findings of a systematic study indicated the protective and enhancing the role of positive resources in reducing negative moods and anxiety (11). Psychological capital can help to control of anxiety through positive resources (9). Psychological capital refers to a person's expandable mental capacity that can be used to improve performance and include hope, self-efficacy, optimism, and resilience (9). Research findings indicated a link between psychological capital and the emergence of mood disorders (12). Positive interventions, with emphasis on psychological capital, help improve psychological well-being and organized behaviors (9).

Two physiological components of stress are the autonomic nervous system and the hypothalamic-pituitary-adrenal axis that are measured by the cortisol response (13). Previous studies suggested that increased anxiety is associated with a significant increase in cortisol levels (14, 15). Studies have shown that these hormonal changes in cortisol levels are associated with psychological consequences such as anxiety and depression (16). Additional studies indicated that high cortisol levels are associated with lower cognitive function (17). Hypothalamic-pituitary-adrenal axis dysfunction can affect cognitive function including executive functioning, memory and processing speed (18, 19). Executive function is considered as a cognitive construct and performs tasks such as problem solving, attention, reasoning, organizing, planning, memory, inhibitory control and response inhibition. Damage in these areas will lead to impaired daily functioning (20).

The results of the study by Mehrsafari et al. (21) showed that the use of psychological interventions have been associated with a decrease in cortisol biomarker in anxious

patients. In this regard, the findings of the study by Rauch et al. (22) showed that patient with lower response to treatment showed higher cortisol levels. Contrary to the findings of Rauch et al. (22), the results of Fischer and Cleare's (23) showed that higher cortisol concentrations during exposure sessions are linked with better treatment outcomes. In versus, the results of the study by Fisher et al. (24) found that depressed patients with high levels of cortisol were less responsive to psychotherapy.

Considering the importance of a positive approach in addressing psychological capital rather than focusing on psychopathology in drawing the advances of psychotherapy and considering the importance of using biomarkers with conventional assessment tools, the present study was conducted aimed to investigate the effectiveness of positive therapy on improving executive functions and modulating serum cortisol levels in patients with subsyndromal anxiety syndrome.

Methods

The present study was a randomized controlled clinical trial conducted in Tehran during November 2018 to January 2019. For this purpose, 30 students with Subsyndromal Anxiety Syndrome were selected using purposive sampling method and entered the research process after confirming the criteria for entering and obtaining informed consent. PPT can be divided into three phases. The first phase focuses on exploring a balanced narrative of the client and exploration of her/his signature strengths from multiple perspectives. These signature strengths are operationalized into personally meaningful goals. The middle phase focuses on cultivating positive emotions and adaptively dealing with negative memories. The final phase include exercises on fostering positive

relationships and meaning and purpose (see table 1).

Inclusion criteria were: 1) age range 18-28 years; 2) study in undergraduate and postgraduate levels; 3) Moderate anxiety score on Spielberg Anxiety Inventory (38-44) (25); 4) Obtained informed written consent. Exclusion criteria were: 1) diagnosis of any acute psychiatric disorder; 2) endocrine-related diseases (due to effect on cortisol secretion), and 3) receiving any drug or psychiatric treatment less than six months up to the study.

Participants were assigned to experimental and control groups through block randomization method. Positive therapy was administered to the experimental group for ten 90-minute weekly sessions and the control group was placed on the waiting list. Changes in the executive functions index were considered as primary outcomes and in serum cortisol level fluctuations were considered as secondary outcomes. Executive functions were assessed through the Executive Functions Short Questionnaire (26). Also, to measure serum cortisol concentration, brachial vein blood samples were taken from the patients at the beginning of the study at a fasting state for 12 h and 8 am. Serum was isolated by centrifugation at room temperature at 3000 rpm for 10 minutes and stored at a negative temperature of 80 ° C until the test. Cortisol was measured using US monobind kit and ELISA with coefficient of variation of 5.3%, permissible value of 5.8% and sensitivity of 6.9 nmol / L. Data were analyzed by multivariate analysis of covariance in SPSS 21 software environment. In order to adhere to the ethics of all participants on the waiting list after the end of treatment, they received six sessions of treatment. All stages of research were conducted according to the latest version of the Helsinki Declaration.

1. Demographics Checklist: This checklist was prepared and used by the researcher to

collect personal information such as the age, educational level and the duration of prevention from using drugs.

2. Structured Clinical Interview (SCID):

It is a clinical interview used to diagnose Axis I disorders based on the DSM-IV. The reliability coefficient between evaluators for SCID is reported to be 0.60 (27, 28). Diagnostic agreement of this tool in Persian language has been desirable for most specific and general diagnoses with reliability higher than 0.60. Kappa coefficient for all current diagnoses and lifetime diagnoses has been obtained as 0.52 and 0.55, respectively (29).

3. Behavior Rating Inventory of Executive Function (BRIEF):

This tool is designed to examine the different aspects of function of anterior part of the forehead. Given the breadth of implementation function, existing questionnaires measure limited aspects of these function. The Executive Function Short Questionnaire is a comprehensive tool designed on the basis of the most recent views on executive functioning. This questionnaire contains 86 items that are scored based on "never (1), sometimes (2), and most of times (3). Eight executive function of Prevention, Orientation, Emotion Control, Inception / Task, Active Memory, Planning, Organizing and Monitoring are evaluated by this tool. The validity and reliability of this tool have been reported as acceptable in the study by Rouel et al. (26).

Also, the results study of Alizadeh Zarei et al. (30) show that the items of Persian version of "Behavior Rating Inventory of Executive Function" has adequate face validity and reliability for the assessment of executive function.

4. State-trait anxiety inventory:

The standard State-trait anxiety inventory is designed to assess the anxiety index. This test consists of two parts, the obvious and the hidden part. The first part of the questionnaire contains 20 expressions for assessing obvious anxiety and the second part contains 20 expressions for determining anxiety. The means of obvious anxiety is the feeling of the individual at the same moment, and the means of the hidden anxiety is the usual feeling of the individual at most times. The items of this tool are designed based on a four-part Likert scale. The sum of scores on each of the two scales of obvious and hidden anxiety ranged from 20 to 80. The obtained anxiety is classified into three levels: mild, moderate, and severe. The validity and reliability of this tool showed unidimensionality, local independence, and adequate index of internal consistency in the study of Kaipper et al. (31). In study of Panahi-Shahri (32), test-retest reliability in the Iranian sample was estimated to be 0.84 for trait anxiety and 0.76 for state anxiety.

Table 1: An overview of PPT model

Session	Topic	Description
1	Orientation to PPT	Psychological distress is discussed as lack of or diminished positive resources
2	Character strengths	Character strengths are introduced. Notion of engagement and flow is discussed.
3	Good vs. bad memories	The role of negative memories is discussed in terms of how they perpetuate psychological symptoms.
4	Forgiveness	Forgiveness is introduced as a tool to transform anger and bitterness and to cultivate neutral or positive emotions
5	Gratitude	Gratitude is discussed as an enduring thankfulness.
6	Satisficing vs.	Concepts of satisficing (good enough) and maximizing are

	maximizing	discussed.
7	Hope and optimism	Optimism and hope are discussed in detail.
8	Positive communication	Active-Constructive –a technique of positive communication is discussed
9	Signature strengths of others	The significance of recognizing and associating through character strengths of family members is discussed
10	Savoring	Savoring is discussed, along with techniques and strategies to safeguard against adaptation

Results

Covariance analysis with elimination of pretest effect was used for data analysis. Before using parametric analysis of covariance, its assumptions were examined. The assumption of normality of distribution was assessed by Kolmogorov–Smirnov test

($p > 0.05$). The results of Levene's test showed equality of variances ($p > 0.05$). Also, results of linearity test showed no significant relationship between pre-test and post-test ($p > 0.05$). The demographic characteristics of the research participants are presented in Table 2.

Table 2: Demographic information of the research sample

Demographic characteristics		Experimental group		Control group	
		Frequency	Percentage	Frequency	Percentage
Age	<20	4	13.33	3	10.0
	20-24	6	20.0	5	16.67
	25-30	3	10.0	4	13.33
	>30	2	6.67	3	10.0
Sex	Male	4	13.33	9	30.0
	Female	11	36.67	6	20.0
Marital status	Married	10	33.33	8	23.33
	Single	5	16.67	7	26.67
Educational level	BSc	10	33.33	9	30.0
	MSc	5	16.67	6	20.0

As can be seen from the findings in Table 1, the majority of participants aged 20-24 and are also women, married and with a bachelor's degree. A description of the

subjects' scores on the executive functions index is presented in Table 3.

Table 3: Distribution of research participants' scores on the executive functions index

Variable	Groups	Test	Descriptive characteristics			
			Mean	Std. deviation	Skewness	Elongation
Executive functions	Experiment	Pre-test	154.77	12.47	0.67	-1.06
		Post-test	175.82	10.32	0.20	0.58
	Control	Pre-test	150.45	9.23	1.02	0.20
		Post-test	463.36	11.05	1.14	0.11

A description of the subjects' scores in the Executive Function Index is presented in Table 4.

Table 4: Distribution of research participants' scores on cortisol level index

Variable	Groups	Test	Descriptive characteristics			
			Mean	Std. deviation	Skewness	Elongation
Cortisol levels	Experiment	Pre-test	2.84	0.64	0.01	-1.00
		Post-test	1.74	0.58	-0.24	-0.94
	Control	Pre-test	2.71	0.40	-0.84	-0.11
		Post-test	2.04	0.38	-0.66	-0.50

The results of the analysis of covariance of mean difference between the inter-group executive functions in the post-test after

eliminating the pre-test effect are presented in Table 5.

Table 5: The results of covariance analysis test in evaluating executive functions between two groups

Source of changes	Sum of squares	Degree of freedom	Mean squares	F	Significance level	Eta square
Modified model	170.01	2	85.05	56.62	0.001	0.98
Intercept	20.44	1	20.44	16.58	0.014	0.07
Pre-test	28.03	1	28.03	4.89	0.036	0.07
Group	78.53	1	78.53	14.95	0.001	0.34
Error	230.69	27	8.23			
Total	527.70	30				
Corrected total	145.71	29				

As can be seen from the findings in Table 4, positive therapy had a significant effect on the executive functions index in the experimental group ($p < 0.001$). The results

of the analysis of covariance of the difference between the mean cortisol level in the post-test after eliminating the pre-test effect is presented in Table 6.

Table 6: The results of covariance analysis test in evaluating executive functions between two groups

Source of changes	Sum of squares	Degree of freedom	Mean squares	F	Significance level	Eta square
Modified model	170.01	2	85.05	56.62	0.001	0.98
Intercept	3.25	1	1.63	3.07	0.04	0.66
Pre-test	2.89	1	2.89	8.20	0.007	0.09
Group	1.03	1	1.03	2.89	0.056	0.05
Error	6.53	27	6.53	30.95	0.001	0.86
Total	5.69	30	0.21			
Corrected total	12.71	29				

As can be seen from the findings in Table 6, positive therapy had a significant effect on cortisol index in the experimental group ($p < 0.001$).

Discussion

This study was conducted aimed to evaluate the efficacy of positive psychotherapy on the improvement of executive function and modulation of serum cortisol level in

patients with subsyndromal anxiety syndrome. This study was the first study in this field. Primary outcomes showed that ten weeks of positive psychotherapy had a significant effect on the improvement of executive function. Secondary outcomes also showed that positive psychotherapy was effective in reducing serum cortisol levels.

Consistent with the findings of the present study, the results of the study by Tang et al. (33) showed that mindfulness intervention was associated with improvement in executive function scores on the self-control subscale. Also, in line with our findings, Taren et al. (34) in their study showed that psychological intervention in the form of mindfulness therapy had a significant effect on enhancing the improvement of executive functions by improving functional connectivity in the brain regions. In this regard, the results of the study by Gotink et al. (35) showed that mental meditation training caused brain structural changes in the frontal cortex, cingulate cortex, insula, hippocampus and amygdala. The study of Lai et al (36) shows that there is a significant relationship between positive mood and low cortisol levels and participants having higher optimism scores exhibited less cortisol secretion in the awakening period when the effect of pessimism and mood were controlled. Also, the results study of Pirnia et al (37) indicated a negative significant relationship between the cortisol level and executive function.

Part of the findings of this study showed that positive psychotherapy reduced cortisol levels in people with mild to moderate anxiety. Although no similar study has been found in the research literature, the research literature suggests the effectiveness of psychological interventions on cortisol levels. In line with our findings, the results of the study by Mehrsafari et al. (21) showed that the use of psychological interventions was associated with a decrease in cortisol

levels in anxious patients. The results of this study suggest psychotherapy to be an effective tool in reducing the stress.

Also, the findings of the study by Rauch et al. (22) showed that higher cortisol levels are associated with more limited therapeutic response. However, the role of cortisol levels varies depending on the type of treatment. For example, the findings of Fischer and Cleare (23) study showed that higher levels of cortisol in anxiety therapy sessions are associated with better therapeutic outcomes. In line with our findings, the results of Fischer et al. (24) study found that depressed patients with high levels of cortisol were less responsive to psychotherapy. The results study of Pirnia et al (16, 38) showed the Hypothalamic-pituitary-adrenal (HPA) axis is considered as a key structure in the anxious patients.

The basis of positive psychology is the focus on human virtues. The virtue of rationality opens the way for reasoning or what is known as cognition. So what results from the optimal impact of positive psychology on executive function seems to be the knowledge and wisdom of the interdependent, which includes the ability to be creative, to judge, to curiosity, to love learning and to form an outlook on the outside world. Learn to experiment with a variety of solutions and not just one solution. Seligman taught us the virtues of uncertainty as a philosopher; the fact that the existing reality is just one of many thousands of events that could have been. This virtue creates the basis for cognitive organization. Along with this ability, the ability of cognitive flexibility is resulted that allows us to examine multiple angles of a problem. The Seligmanian perspective provides the context for cognitive organizing so that we can deeply understand each event and anticipate future possibilities. Seligman connected this phenomenon with depression, noting that many people

suffering from depression feel helpless as well. His work on the subject provided inspiration, ideas, and evidence to back up many treatments for depressive symptoms, as well as strategies for preventing depression.

Psychology now seems to need a more efficient map of optimal human performance than ever before. The future task of positive psychology is to understand the factors that drive empowerment. Finally, positive psychology requires the development of effective interventions to enhance and enforce these processes.

This study was not without limitations during the implementation process. The main limitation of the present study was the inability to track the results of therapy. The use of self-reporting tools in assessing executive functions indices can also be biased. It is suggested that biomarker evaluation should be used alongside the questionnaire in future studies. Also, the use of positive therapy as part of a brain rehabilitation process can be a good route for future studies.

Conflict of interest

The authors did not declare any conflicts of interest.

Acknowledgement

The authors are grateful to all the people who participated in this study and helped to facilitate the research process.

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