

The effect of cognitive reappraisal strategy on cognitive functions in disgust induction situation among under medication obsessive-compulsive patients

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ABSTRACT

The aim of this study is to investigate the effect of cognitive reappraisal strategy on cognitive functions in disgust induction situations among obsessive-compulsive patients. This study was a pre-posttest research design with a control group in experimental environment. Participants consisted of 44 individuals with obsessive-compulsive disorder who were selected from mental health clinics of Kashan, Iran. Participants were randomly assigned to one of two conditions. All participants provided background questionnaires including Yale-Brown Obsessive -Compulsive Scale (YBOCS), Padua Inventory (PI), Emotion Regulation Scale (ERQ), the Beck Depression Inventory-II (BDI-II) and disgust propensity and sensitivity scale and the cognitive function tasks including Iowa Gambling Task (IGT), Wisconsin Card Sorting Test (WCST) and Stroop Task (ST). The induction only condition (IOC) as control group had not received training beside the disgust emotion induction. In post-test phase after watching disgust induction films, subjects were asked to answer the cognitive tests again immediately after they watched to a minute's disgust films in three steps. Covariance analysis tests was used to analyze data and results showed that the cognitive reappraisal training (CRT) group outperformed in post-test step in IGT, reaction time in ST and the correct answers in WCST. Accordingly, we could suggest that cognitive reappraisal as an emotion regulation strategy could improve the decision-making, inhibition and set shifting in disgust induction situation.

Keywords: Obsessive-compulsive disorder, cognitive reappraisal, risky decision-making, set shifting

INTRODUCTION

Lifetime prevalence of obsessive-compulsive disorder (OCD) are estimated approximately 2 to 3 percent in population. In terms of prevalence, OCD is the fourth psychological disorder (1). Neuropsychological studies have shown some cognitive functions impairments in OCD patients including decision-making(2), inhibition control(3) and set shifting(4). Also, many of patients with OCD suffer from negative emotions including shame(5), anxiety, distress (6) and disgust(7). Interaction between cognitive and emotion in neuro-circuits lead to decision making and actual behaviors(8). There are two categories for related systems with cognition and emotion. The first one is the anterior system including Amygdala, Insula and orbitofrontal (ofPFC), and ventro-lateral (vlPFC) prefrontal cortex. This system is responsible to differentiate the environmentally emotional stimulus and to express emotions. The second system is the posterior one which includes hippocampus and posterior areas of prefrontal cortex (PFC). It integrates the cognitive processes and impacts on the emotional inputs which are so important for cognitive functions performance such as selective attention, planning, making a decision,

auto-adjusting the emotional modes and inhibition(9). The emotions are formed in the limbic system (LS) and are identified, managed and controlled by PFC (10). Controlling of emotions are fulfilled by cognitive functions(11). Anterior Cingulate Cortex (ACC) and medial PFC (mPFC) have a regulatory role with respect to limbic regions involved in generating emotional responses(12). Changes that occur during stress rapidly disrupt PFC network connections and markedly impair PFC function that individuals could not control their emotions(13). Low function in PFC increases the impulse behaviors(14). One of the emotions in individuals with OCD is disgust that is related to the occurrence of obsessive symptoms (15, 16). The disgust emotion play a substantial role in the nervous and mental systems of individuals with OCD (7). Related literature to brain areas involved to detect the disgust emotion showed that the individuals with OCD have some impairments in detecting disgust representation compared with healthy control and individuals with other anxiety disorders (17, 18). Altogether, the nervous connections between insula and PFC indicate that the disgust emotion related to cognitive

functions(19). The impact of disgust emotion on decision-making mechanisms showed that the individuals who experience the disgust situations have some problems to decision making (20, 21).When individuals experience disgust situations, inhibition control(22)and attention function(23) decrease. The emotions could be adjusted through emotion regulation strategies. Emotion regulation can be defined as the manner in which individuals influence, experience, control, and express their emotions. Most theories suggested that the individuals who could not manage their emotional reactions effectively, they experience events in longer periods and more intense stress. This lead to anxiety, depression and obsessive reactions(24). Cognitive reappraisal (CR) is one of the emotion regulation strategies which has defects in anxiety and obsessive disorders and individuals could not appraise the situations correctly(25). This strategy changes the situations' conceptualization in order to reduce its emotional effects. Reappraisal involves emotion generating or positive interpretations or perspectives on a stressful situation as a way of reducing distress(26). CR could improve the performance of brain areas related to cognitive functions and reduce the negative emotional experiences(27, 28). When individuals are exposed to unpleasant stimuli, they are not able to focus on more options, as a result of which they are affected by these stimuli and decisions are disturbed(27).The emotion regulation is a combination of cognitive, emotional and behavioral processes and individuals with mental disorders indicate the obvious defect in emotion regulation and cognitive process. Emotional defects of patients with obsessive-compulsive disorder are clearly observable due to their exaggerated emotional reactivity. When the negative emotions get exited in OCD population, they could not detect, describe and percept their emotions correctly which is related to the distress intolerance and impulsive behaviors(29). The relationship between emotional experiences and inhibition control has shown that the negative emotions make difficult the information processing and the inhibition of the irrelevant information(30). One of the cognitive functions which individuals use it to regulate their emotions is to attend and change the attention from one situation to another. Such function need to two important mechanisms that one first should detect the rules related to tasks and then reduce the interplay between tasks through creating inhibition processes while comparing. Dys regulation in process of set-shifting is the underlying factor in etiology and maintenance of anxiety disorders(31). Evidences show that if the individuals increase their attention when experience emotions, they will reduce their emotions reactions(32).The aim of this study was to determine the effect of CR strategy on risky decision making, set shifting and inhibition in disgust induction situation among obsessive-compulsive disorder patients in vitro environment. Given to the

role of emotions in cognitive functions, the present study attempts to answer the question that whether could CR change the impact of disgust emotion which interferes with the cognitive functions in individuals with OCD and improve the cognitive functions through disgust control?

Method

Participants

The sample was selected from mental health clinics in Kashan, Iran. Participants were under medication. All participants were at optimal target doses of Fluoxetine 20 mg, Citalopram 10 mg, Fluvoxamine 50 mg, Sertraline 50 mg, Clomipramine 25mg, Clonazepam 5 mg and Alprazolam 25 mg. Inclusion criteria consisted of: having a primarily diagnosis of OCD based on DSM-IV-TR (diagnosis through structured clinical interview SCID-I for axis I disorders) and having at least a high school education. Exclusion criteria included: having no informed consent to participate in the study, low success level in cognitive reappraisal emotion regulation strategy, low success in disgust emotion induction, current diagnosis of bipolar and major depression disorders, current psychotic episode, and substance abuse or dependency. A psychiatrist screened 87 individuals for the study, but 44 patients were studied ultimately. This resulted in 44 participants who were randomly assigned, using a random number chart, to one of two conditions. The experiment group received the cognitive reappraisal emotion regulation strategy training (CRT) before exposed to disgust induction, but the induction only condition (IOC) as control group did not received any training and their cognitive functions were measured before and after the induction.

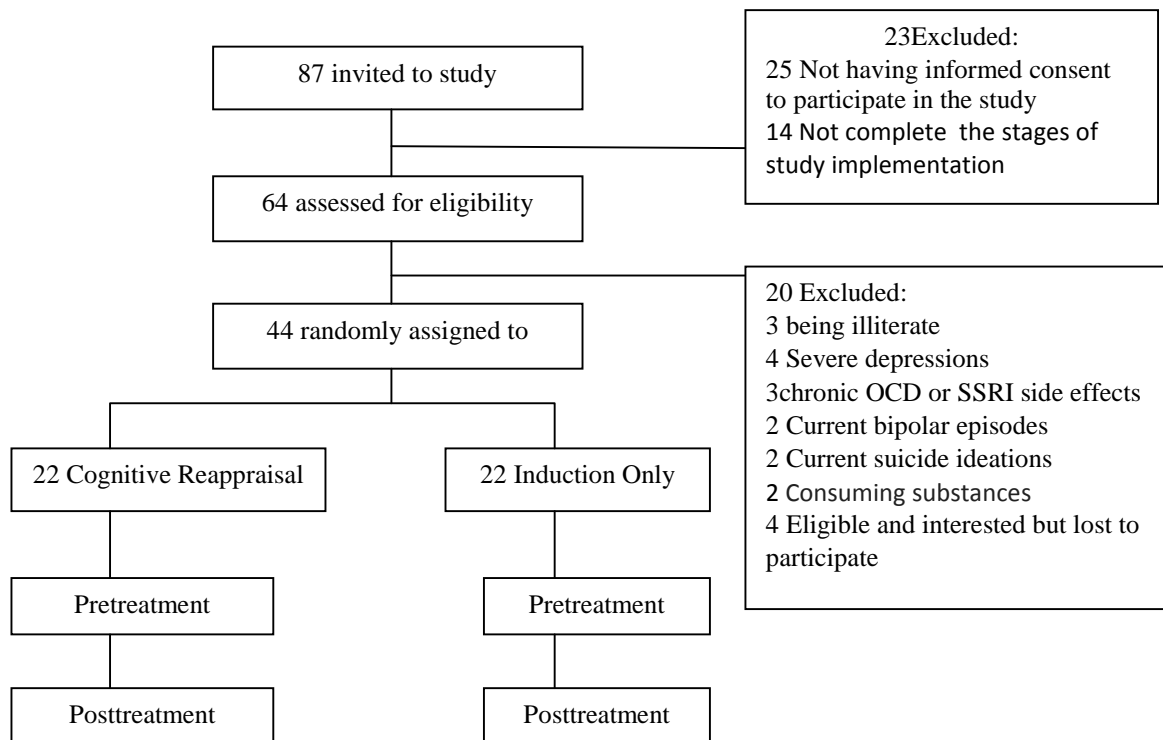
Procedure

All participants were provided information about the two study conditions and provided informed consent to participate in the study. In the next step, participants were randomly assigned into two groups. This study was conducted in two steps. The first one was preliminary stage including to prepare the disgust induction film and gather primary measurement tools. To end this, 10 individuals with OCD based on psychiatrist diagnosis were selected randomly and were asked to watch to the disgust films scenes which were provided by the researcher through international emotional images(18). This was to obtain the disgust situation intensity and to be able to rate them according visual analog between 1 (minimum disgust level) and 10 (maximum disgust level). Then, we mix high disgust intensity scenes in order to prepare the final version of the film. Therefore, three videos were made (one minute time). In the next step, all participants provided demographic information at pretest. In addition, an assessment battery was completed by participants at pretest, and posttest. Then, disgust induction was

applied in both CRT and IOC groups. Before disgust induction, the CRT was trained the strategy of cognitive reappraisal emotion regulation according to the below described protocol. PEBL software was used to measure the cognitive functions. Immediately after showing one minute videos, one of the cognitive function tests was performed as posttest. **IOC management.** The following instruction was conducted for IOC group: "You will be shown a short video. Please, watch it carefully. However, if the film was stressful for you, it is sufficient to tell us, stop, we will stop it." **CRT condition.** The instruction of CRT was as follows according to (33): "Now, a short video will

be displayed you. Please, watch it carefully. During this time, try to watch the video scenes emotionless. Note that they are separate from you and do not belong to you. In other words, try to think about other things during watching the video. For example, note to the technical aspects of the events seeing on the video. The participants will be told that these scenes have been made by individuals who want to create such emotions in you. These scenes are not real movies. Please, watch the clips, however try to imagine the video scenes, so that, they could not arouse your emotions at all.

Figure 1. Participant Flowchart



Measures

Structured clinical interview for axis I disorders (SCID-I). SCID-I has been widely used to diagnosis axis I disorders based on DSM-IV by trained clinicians. In Iran, Sharifi et.al, studied its psychometric properties. The results of this scale reliability test and test-retest for OCD were obtained 90.3 for lifetime and 91.5 for recent attack. Also, its validity were 0.48 with sensitivity 0.64 and being special 0.92, which was tested using K test. These values showed that its psychometric properties were suitable for Iranian population(34).

Yale-Brown Obsessive-Compulsive Scale (Y-BOCS): This scale has been provided by Goodman et.al to measure obsessive-compulsive symptoms. This scale has 10 items and has subscales including obsessive thoughts and impulse behaviors. The scores was rated based on Likert five points scale including 0 (without symptom) and 4 (intense

symptoms). Cronbach's alpha was calculated from 0.95 to 0.97. KMO index was more than 0.80 in determining structural validity in Iranian population(35).

Padua Inventory (PI): This scale has 39 items and its objective is to assess and measure OCD level in terms of different dimensions including contamination obsessive, washing compulsions, order and arrangement compulsions, self-harm obsessive thoughts, roughness obsessive thoughts, obsessive impulses to her/himself and others. This inventory was standardized by Shams et.al (36) in Iran which its reliability and internal consistency was calculated 0.92 using Cronbach's alpha, split-half test coefficient was 0.95 using Spearman correlation test and its reliability was 0.77 using test-retest (36).

Emotion Regulation Questionnaire (ERQ): This scale was provided by Gross and John to assess individual differences in habitual using of cognitive reappraisal

emotion regulation and expression suppression strategies. ERQ has 10 items and scored through Likert five points scale. Ghasempour et.al, reported the scale's reliability in Iranian sample. These researchers calculated its internal consistency 0.81-0.60 using Cronbach's alpha and its validity through Principal Component Analysis (PCA), Varimax rotation and the correlation between two subscale ($r=0.13$) and suitable criterion validity(37).

Beck Depression Inventory-II (BDI-II):The BDI-II is a commonly used, self-report measure of depression. The measure consists of 21 items that are summed to produce a total score (range = 0–63). The BDI-II has demonstrated good psychometric properties in Iranian samples. The alpha coefficient of the Iranian version is .86(38).

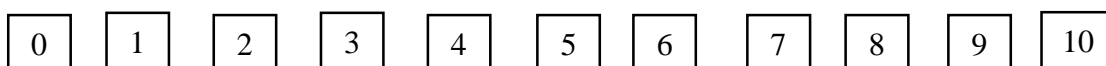
Wisconsin Card Sorting Test (WCST): This scale is one of the known psychological tests measuring abstract reasoning, psychological flexibility, perseveration, problem-solving, set shifting, starting and stopping strategies and attention keeping. This test was provided by Berg(39) and has 64 cards which are different based on color, number and shape and the testees should recognize the differences. Its reliability and internal consistency reported as 0.92 and 0.94, respectively. Spearman and Strauss reported its reliability 0.82 according to evaluators' agreement coefficient.

Iowa gambling test (IGT): In this test, 4 cards are provided in 100 steps as A, B, C and D. A and B cards are known as risk cards which lead to immediately reward and long-term failure. C and D cards include short-term failure and long-term reward. IGT has suitable validity to assess the individuals risky decision-makings based on somatic marker theory (STM)(40).

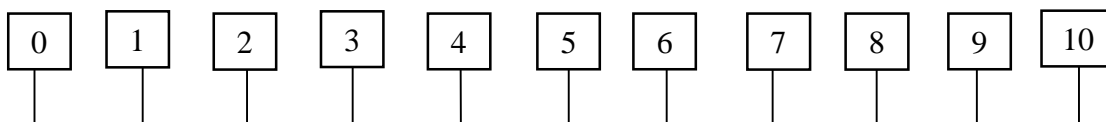
Stroop color and word Test (ST): This scale is one of the most used tests related to selective attention and response inhibition and is known as basic test to assess the brain frontal function. Its scoring and interpreting of the scores were calculated using error test, correct numbers test, reaction time test and interference score (reaction time to inconsistent and consistent words). In some studies, reliability of ST was calculated as 0.06, 0.83 and 0.90 for each three attempt, respectively. Its congruence validity was 0.89 which was calculated by emotional Stroop test(41).

Disgust Propensity and Sensitivity Scale-Revised: This scale was provided by Kwang and Davey and has 32 items. Van Urdel et.al (42) improved it and has provided a 16 items scale including two 8 items subscale related to sensitivity and tenderness to disgust. 16 items version was scored using Likert five points scale (never, seldom, sometimes, most of time and always). In Iran, it was standardized by Zanjani et.al(43) on 400 individuals. In our study, we used from test-retest and internal consistency test to consider its reliability. Results showed that internal consistency through Cronbach's alpha was 0.83 for whole scale and it was 67%, 65%, 76% and 71% for the first and fourth factors, respectively. We performed test-retest in 4 weeks interval for whole scale (44%) and it was -62% and 54% for the first to fourth factors. Also, congruence validity test was used to measure its validity and its correlation was measured with Padua scale and subscales including fear of contamination and improved disgust scale which its results indicated its congruence validity and its scores were 39%, 44% and 51%, respectively.

Visual Analog scale of induced disgust level: The participants rated their induced emotions in 0-10 degree which we control the scores in experiment group using statistical methods.



Visual analog scale for testing the success in cognitive reappraisal strategy: Participants rated their success level in performing cognitive reappraisal strategy on 0-10. Then, we control the scores in the experiment group using statistical methods



Data Analysis

Kolmogorov-Smirnov and Levene's methods were used to test for distribution normality and equality of variances ($p<.05$) and parametric tests were utilized for statistical analysis. Demographic data were analyzed employing chi-square and independent two-sample student's t-tests. ANCOVA tests were utilized to compare two groups in posttest.

Results

Table 1 shows that age mean of IOC was 32.22, and of CRT was 33.27 suggesting that there was no significant difference between two groups according to t test ($t=0.375$, $p> 0.05$). In IOC and CRT, 36% and 50% had academic education, respectively. Chi square test results suggested that there was also no significant difference between two groups in academic education background ($X^2=1.036^a$,

p> 0.05). 77.3% of IOC and 81.8% of CRT were female. Chi square test showed that there was no significant difference between two groups in terms of gender ($X^2=0.140^a$, p> 0.05).

Table 1: Demographics by Treatment Condition

	IO (n = 22)	CR (n = 22)	t or Z	p
Age M (SD)	32.2273	33.2727	.375	.710
Percent with College Degree	36%	50%	1.069 ^a	.785
Gender (Females)	77.3%	81.8%	.140 ^a	.709
SSRIs medication	86.4%	77.3%	.611 ^a	.434
BDI-II	20.4545	21.3636	.264	.793
PADUA	36.8182	34.5909	-.502	.618
YB-OBS	11.0455	12.3182	1.516	.137
YB-COM	10.5909	10.7727	.252	.803
ER-CR	16.8636	18.0909	.763	.450
ER-SUP	20.5909	18.1364	-1.508	.139
DISGUST	24.63	20.77	1.232	.225

NOTE: BDI-IIBECK DEPRESSION INVENTORY-II.PADUA PADUA INVENTORY OF OBSESSIVE COMPULSIVE DISORDER SYMPTOMS. YB- OBS YALE BROWN OBSESSIVE.YB- COM YALE BROWN COMPULSIVE. ER-CR Emotion Regulation – Cognitive Reappraisal. ER-SUP Emotion Regulation- Suppression. DISGUST Revised scale of sensitivity and tendency to experience of disgust.

According to table 1, t test results showed that depression ($t=0.264$, p> 0.05), obsessive-compulsive scores in Padua scale ($t=0.502$, p> 0.05), obsession using Y-BOCS ($t=1.516$, p> 0.05), compulsive using Y-BOCS ($t=0.252$, p> 0.05), cognitive reappraisal subscale of ERQ ($t=0.763$, p> 0.05), repression of ERQ ($t=1.508$, p> 0.05) and disgust level ($t=23.1$, p> 0.05) means was not significantly different between two groups. According to visual analog, induced disgust mean and SD were 5.22 and 2.93 in CRT, and 7.37 and 3.89 in IOC, respectively. It indicated that CR group had experienced low disgust after receiving induction ($t= 2.06$, p< 0.05, $d = 0.62$). The mean and SD of success level in CR were 6.31 and 1.96, respectively (range4-9).According to table 2, in posttest in experiment group, decision-making mean in CR group was significantly less than pre-test ($d=1.23$, $F= 7.077$, p< 0.05), while, risky decision-making mean has statistically decreased in posttest in control group than pre-test ($d=1.23$, $F=7.077$, p< 0.05). ANCOVA test results showed that in posttest two groups significantly different in risky decision making. In other words, risky decision-making level showed more reduction in CR group.

Reaction time mean of CR group in Stroop test in posttest has significantly decreased in compared with pre-test ($t=-1.23$, p< 0.05). However, this variable increased in posttest in control group than to pre-test ($t=-1.23$, p< 0.05). In addition, ANCOVA results showed the significantly difference between two groups and the average effect of intervention on the experiment group ($F=6.96$, $d=-0.063$, p< 0.05). Correct answers increased in CR group in posttest in compared with pre-test ($t=3.046$, p< 0.05). While, correct answers had no change in control group in posttest than to pre-test ($t=3.046$, p< 0.05). ANCOVA test results suggested no significantly difference between two groups in posttest and lack of effect of this variable in CR group ($d= 1.93$, $F=6.96$, p< 0.05). In other words, emotion induction increased response time suggesting that individuals' inhibition level has decreased under emotional situations. CR decreased response time and increased correct answers, i.e. cognitive reappraisal could impact on the response time of the individuals and improve the inhibition level. Correct answers in Wisconsin test has significantly increased in CR group in posttest than to pre-test ($t=-4.39$, p< 0.05).

However, this variable has relatively increased in posttest than to pre-test ($t=-4.39, p< 0.05$). As well, ANCOVA test results showed significantly difference between two groups and intervention effect on CR group ($d=0.26, F=5.88, P> 0.05$). Cognitive perseveration mean in experiment group in posttest has decreased than to pretest ($t=1.779, p< 0.05$). In control group, this variable mean has also decreased in posttest than to pretest ($t=1.779, p< 0.05$). The results of ANCOVA test suggested no significantly

difference between two groups in posttest and no intervention impact of this variable in CR group ($d=-0.052, F=3.16, P> 0.05$). In other words, CR increased correct answers suggesting that CR could impact on the OCD individuals. However, it was no significant given to perseveration level. Generally, a quick look to table 2 results suggested that significant changes has been made in experiment group in decision-making, reaction time, correct answers numbers in Wisconsin test in posttest than to pre-test.

Table 2: Means and Standard Deviations at Baseline and Post induction by Condition

Measure	CR (n = 22)		IO (n = 22)		Cohen d	p
	Pre	Post	Pre	Post		
IGT (A+B)	29.36 (4.66)	22.90 (3.33)	27.27 (4.11)	26.27 (4.90)	-1.23	0.011
ST-time	192.79 (71.63)	183.77 (88.24)	215.79 (77.86)	254.73 (77.28)	-0.637	0.012
ST-Re	74.90 (2.87)	84.40 (14.37)	77.13 (6.29)	77.13 (8.15)	1.931	.060
Correct-R WIST	87.18 (20.46)	103.54 (6.29)	83.63 (23.74)	94.04 (17.06)	0.267	.020
PE- WIST	18.09 (12.92)	12.77 (3.40)	20.63 (18.09)	16.13 (9.02)	-0.052	.082
DIST-ANA		5.22 (2.93)		7.38 (3.89)	0.62	0.045

Note: IGT Iowa Gambling Test. DISG-ANA Disgust analogue. ST-time Stroop Time. ST-Re Stroop Responses. Correct-R WIST Correct response Wisconsin Card Sorting Test. PE- WIST Perseverative Error Wisconsin Card Sorting Test. CR- ANA Cognitive Reappraisal analogue

Discussion

In our study, we address the cognitive reappraisal emotion regulation strategy in disgust emotion induction situation impacts on the cognitive functions of individuals with obsessive-compulsive disorder (OCD). Results showed that the education of cognitive reappraisal emotion strategy in disgust emotion induction situation has significantly increased the decision-making, inhibition response time and set-shifting in individuals with OCD. Generally, the patients who received the cognitive appraisal education improved their cognitive functions compared with the ones in control group who received the disgust induction situations without cognitive reappraisal education. Our study results are in line with the literature related to role of emotions in cognitive functions(44, 45). Cognitive and emotion interactions have been reported in literature which PFC, e.g. attention control, Information keeping, decision making, cognitive inhibition role is more prominent(28, 46). In addition, PFC integrates emotions related to Limbic

system. Accordingly, emotions and cognitive are integrated functional systems which affects each other, continuously(47). Most of studies confirmed that individuals with OCD have impairments in cognitive functions including decision making, set-shifting, inhibition and emotion regulation(48). The main objective of this study was to consider the impact of cognitive reappraisal emotion regulation strategy on cognitive functions in disgust induction situation in individuals with OCD. Results showed that after cognitive reappraisal education, the decision-making scores has decreased in CR group than to Control group which is in line with literature related to the emotion regulation impacts on the cognitive functions that emotion regulation strategy improved cognitive functions through impacting on the different parts of brain(49, 50). However, impact of this strategy on the individuals with OCD in disgust induction situation has not been explicitly considered. Previous studies highlighted the function of middle ventricular pre-frontal cortex in CR group.

Since, middle ventricular pre-frontal cortex structurally related to the amygdala, success in CR decreased negative experiences, as its function has been confirmed in risky decision making(20). When the participants used from CR, their unsuitable emotion experiences were significantly decreased and consequently they decreased risky decision making. As well, results showed that the strategy increased response time in subscale of response time impact on inhibition in experiment group. However, it was not reported significantly impact on the correct answer numbers. While, the impact of the cognitive reappraisal on inhibition if individuals with OCD has been neglected in the literature. Individuals with OCD have some problems in cognitive and emotion functions. According to literature, such individuals reappraised the situation more disgusting and as a result they could not show inhibition in their functions(51, 52). Literature has showed that sensitivity to disgust intermediate the relationship between negative emotions and contaminant symptoms in OCD. Therefore, it could be considered as an important factor in prediction OCD symptoms(53). In the other hand, CR could decrease negative emotions as a result of decreased insula and amygdala responsiveness. In general, it impacts on decision-making, response inhibition and attention emotions and CR decreases emotional responses path through reformulating the situations meanings. Consequently, it could make progress in controlling emotions and improve cognitive responsiveness including inhibition, decision-making and set shifting improvement(54). Results showed that the correct answers in set-shifting scores has increased after cognitive reappraisal education in experiment group and their perseveration has decreased suggesting the impact of CR on increased set shifting scores compared with control group. Our results is in line with previous studies which highlighted the significant impact of emotion regulation strategies on set shifting and attention. As well, impacting on brain structures, cognitive reappraisal cause that individuals could change their attention level to situations through recovering new situations in order to decrease such situations emotional effects(55). Given to similar brain structures in cognitive functions and emotion regulation, when emotion regulation improves, cognitive functions improves, too(56). Reviewing of related literature, we could claim that failure to regulate emotions play role in the occurrence of OCD. Disgust sensitivity play a substantial role in mental contamination of individual with OCD and it cause that OCD symptoms persist through increased maladaptive behaviors(15). As well, not compromised strategies of emotion regulation paly role in creating and persisting mental injuries through confronting with self-regulatory objectives during emotional distresses. Totally, emotion regulation strategy is considered as a basic principle

in starting, assessing, maintaining and organizing of compromised behaviors as well as in preventing of negative emotions and not compromised behaviors. Cognitive reappraisal means that individuals could cognitively reappraise or the situations raising potential emotions in order to decrease their emotional effects(57, 58), as the results of our study suggested that emotion regulation using cognitive reappraisal emotion regulation strategy could change the cognitive functions. Our study had some limitations. For example, participants could not use of medicine during study period which could impact on the individual's cognitive functions. So, pharmacotherapy control was impossible in our study. The small number of sample size and the time gap created between disgust emotion induction and cognitive tests which might decrease disgust effect were the other limitations. Suggestions for future researches are as follows. Other cognitive variables are also considered in the study of individuals with OCD. Also, it can be recommended that a separate study is conducted on normal people and individuals with OCD. In future studies, using of neuropsychological tools including EEG and fMRI under disgust induction situation and CR could provide valuable information about involved areas of brain in disgust emotion and CR action mechanisms in such patients. Study more subjects could be the other suggestion for the future researches.

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