

Original Article

Inhibition and activation systems of behavior and suicide mediating role of cognitive emotion regulation

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Abstract

Background: This study aimed to predict suicide attempts based on behavioral activation and inhibition systems (BAS/BIS) with the mediating role of cognitive emotion regulation (CER) strategies among adolescents of Abyek City.

Methods: The research methodology was descriptive-correlational. The cluster sampling method was used, and the resulting sample included 194 adolescents who responded to the BAS/BIS questionnaire (Carver & White, 1994), CER questionnaire, and Beck scale for suicide ideation. Path analysis was employed to evaluate the proposed model using AMOS 24.0 and SPSS 27 software.

Results: The findings indicate that the proposed model is fitted with the data well. The results of path analysis showed that the BAS/BIS systems explain 27% of the variance of maladaptive CER and 61% of the variance of adaptive CER. In addition, maladaptive CER, BAS, and BIS explain 65% of the variance of suicide attempts.

Conclusion: Low levels of BAS, high levels of BIS, and the use of maladaptive CER skills can be considered risk factors for suicide attempts in adolescents.

Keywords: Adolescent; Behavior; Emotional Regulation; Suicide.

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Introduction

Considerable biological, psychological, and social changes characterize adolescence. This stage of development may cause confusion, weakness, vulnerability, or even serious mental health problems (1). On the other hand, suicide is a serious public health problem in the United States and other countries, so in 2018, 48,344 Americans lost their lives due to suicide (2). Suicide is one of the leading causes of death in all age groups and the second most common cause among young people aged 10 to 34. Each complete suicide corresponds to about 29 suicide attempts (3). The suicide rate in the

United States has increased by nearly 30% from 1999 to 2016 (4). It is estimated that 800,000 people die due to suicide annually, with a global mortality rate of 16/100,000. In other words, one person dies by suicide every 40 seconds (5). In Iran, on average, 8.14 (7.8 - 8.5) people die by suicide per 100,000 people of the general population (5% women and 9.1% men) (6). In recent years, there has been a growing concern about the increasing number of suicide cases among Iranian adolescents, as 1.4% of 1517 Iranian students had suicidal thoughts (7). As a result, risk factors leading to suicide need to be investigated

and considered in the development of targeted prevention programs, especially for adolescents (8).

The motivational-volitional model of suicidal behavior suggests that negative self-evaluations cause a person to feel trapped and consider suicide as a possible strategy to regulate her/his negative emotions (9). Emotional regulation includes managing positive and negative emotions arising from a wide range of stressful and non-stressful situations (10). Wong and Chung investigated child abuse and non-suicidal self-injury among Chinese university students. They examined the role of emotion regulation disorders and attachment styles (11). The results of structural equation modeling showed that emotional dysregulation and attachment styles did not moderate the relationship between child abuse and non-suicidal self-injurious behaviors.

A prominent viewpoint in the etiology of psychological disorders is the biological viewpoint. It seems that individual physiological differences make some people more prone to psychological disorders (12). Reinforcement sensitivity theory proposes three brain systems: BAS, BIS, and fight-flight (FFS) (13). The BIS is sensitive to novel and punitive stimuli associated with avoidance and escape behaviors. On the contrary, BAS is sensitive to signs of reward, pleasure, and freedom from punishment and is associated with reward-approach behaviors. It consists of three sub-components (12), i.e., fun-seeking (BAS-F), reward responsiveness (BAS-R) (i.e., tendency to seek exciting and potentially rewarding situations), and drive (BAS-D) (persistent behavior in pursuit of a goal). Finally, the fight-flight system responds to unconditioned aversive stimuli and seems to increase fear, which is only related to self-harm and suicide behavior (14). Low BAS and high BIS had an indirect effect on suicidal thoughts by reducing self-reflection. Bryan et al. concluded that low levels of BIS and

sensitivity of BAS were negatively correlated with suicide attempts. At moderate levels of BIS, activation system sensitivity was not correlated with suicide attempts, but at high levels of BIS, activation system sensitivity was positively correlated with suicide attempts (15).

In general, research on structural models and path analysis can increase awareness of antecedent and consequential variables and clarify the role of moderating variables and the intermediate link between antecedents and consequences. In addition, it can be an essential step to moderate suicidal behavior and thoughts by teaching emotional regulation skills. These factors, together, double the research and economic necessity of conducting the present study. On the other hand, the use of most organizations, including education organizations, medical sciences universities, welfare organizations, and other institutions aiming at reducing social harms, of these factors can increase awareness and insight and, consequently, play an essential role in mobilizing and the unity of most organizations in taking preventive programs. Regarding the role of constructs such as emotional neglect, emotional regulation, and suicide attempts in this research, this study seems to be the first one to examine the role of biological and psychological variables in adolescents, which adds to its originality. Therefore, this research aimed to examine the relationship between BAS/BIS systems and suicide attempts with the mediating role of CER strategies among adolescents in Abyek City.

Methods

The present cross-sectional research was an analytical-correlational one that employs the path analysis method. The research population consisted of all adolescents aged 16 to 19 from Abyek City who were studying in high schools in the academic year 2022-2023. Overall, 194 adolescents participated in the study.

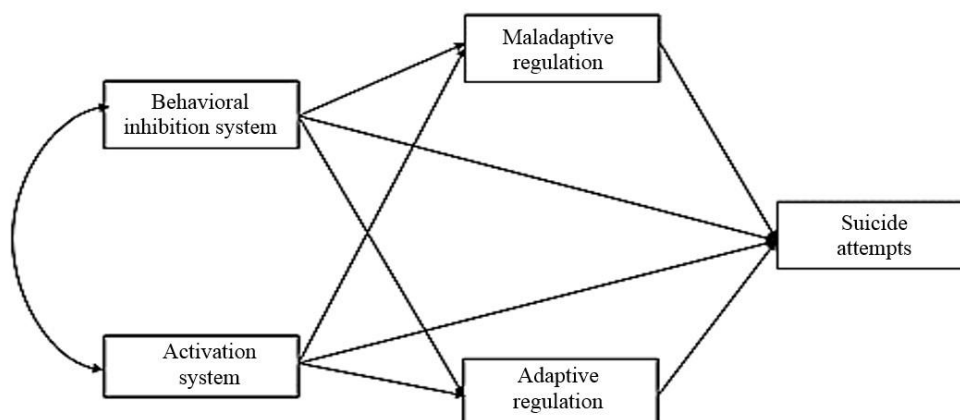


Figure 1. The conceptual model of the present research

This research employed a multi-stage cluster sampling method, and 194 high school students were selected. The inclusion criteria include informed consent, the age range of 16 to 19 years, the absence of physical disabilities and suffering from chronic diseases, and not using medication for their physical and mental condition. The exclusion criteria included reluctance to participate in the study, hospitalization during the last year due to physical and mental conditions, and incomplete or unsuitable responses to the questionnaires. Data was collected only after obtaining the informed consent of all participants, and the students were given the necessary explanations regarding the purpose of the research. The participants were given the necessary assurance concerning information confidentiality, freedom to participate in the study, and the anonymity of their identity information. In addition, the students were allowed to withdraw from the research at any stage. Consistent with Klein's (16) viewpoint on the path analysis, this research considers at least five and at most 15 samples. Therefore, considering the number of items in the questionnaire, the sample size was estimated to be 200. However, after collecting and removing the distorted and non-answered data, 194 participants were qualified to be included in the analysis.

Cognitive Emotion Regulation Strategies Questionnaire (CERQ): The CER strategies questionnaire was prepared by

Garnefski et al. (10) in the Netherlands, and it has two English and Dutch versions. This questionnaire is a self-reporting tool with 36 items. It consists of 9 subscales and three items. Five subscales of this questionnaire are positive emotion strategies, and the rest are maladaptive CER strategies. Adaptive strategies include acceptance, positive reappraisal, objectivity, refocus on planning, positive reevaluation, and maladaptive strategies include self-blame, rumination, catastrophizing, and blame others. The range of scores for each scale is from 1 (almost never) to 5 (almost always). Garnefski et al. (10) reported the Cronbach's alpha in the retest phase for each subscale of the questionnaire as follows: self-blame 0.81, acceptance 0.80, rumination 0.83, refocusing 0.81, refocus on planning 0.81, positive reappraisal 0.72, objectivity 0.79, catastrophizing 0.72, and blame others 0.68. Furthermore, they confirmed its validity by using factor analysis. Hasani (2018) validated the Persian version of the questionnaire and examined Cronbach's alpha value for each subscale. self-blame 0.87, acceptance 0.80, rumination 0.85, refocusing 0.77, refocus on planning 0.81, positive reappraisal 0.85, objectification 0.79, catastrophizing 0.82, and blame others 0.85(17). in addition, Cronbach's alpha for the whole scale was 0.92.

Beck suicide ideation scale (BSSI): The suicidal ideation scale was developed by Beck (18) to measure a person's

susceptibility to suicide. This scale consists of 19 items that are graded by Ballinger on a three-point scale from 0 (lowest intensity) to 2 (highest intensity). The validity and reliability of Beck's suicidal ideation scale has been confirmed in various studies. Cronbach's alpha (internal consistency) and concurrent reliability of this scale were 0.89, 0.96, and 0.83, in order (18). This scale was validated in Iran by Anisi et al. In addition, its reliability was reported using Cronbach's alpha (0.95), and its concurrent validity was reported using the depression scale of the General Health Questionnaire (0.76)(19). The reliability of this questionnaire using Cronbach's alpha was equal to 0.91 in the present study.

Brain-behavioral systems questionnaire by Carver and White (1994): Carver and White designed the inhibition/activation scale. It evaluates the activity level of behavioral brain systems and includes 20 items. In addition, it uses a 5-point Likert scale, in which 1 refers to completely disagree and 5 to agree completely. This scale has two subscales, including the BAS and BIS subscales. The BIS subscale uses seven items to measure the system sensitivity, and the activation system subscale includes 13 items and measures the system activity (20). Johnson et al. reported that internal consistency for inhibition and activation subscales are 0.74 and 0.73, respectively(21). The questionnaire's reliability was calculated using Cronbach's alpha coefficient, which was 0.74 for BIS and 0.77 for BAS.

To collect the data and implement the questionnaires, a permission letter numbered 56919/64 was obtained from the education and training organization of Abyek City, and the necessary coordination with the education officials was performed. Then, each school was initially considered as a cluster. Necessary explanations were given to the students regarding how to answer the questionnaires, the research purpose, the necessity of their honest cooperation, and the inclusion of their

names and surnames were not necessary. The mean and standard deviation were used to report the descriptive findings, and Pearson correlation analysis and path analysis using SPSS 26.0 and AMOS 24.0 were employed to test the research hypotheses. The two-step method proposed by Anderson and Gerbing (22) was used to test the path analysis model concerning the effect of emotional neglect on suicide attempts with the mediation role of CER.

Results

The participants' age distribution is as follows: 66 people (35%) were 16 years old, 63 people (31%) were 17 years old, and 65 people (34%) were 18 years old. In addition, 113 (73.7%) students were girls, and the rest 81 (26.3%) were boys. The mean, standard deviation, and normality assumption, in terms of skewness and kurtosis, of emotional neglect variables, behavioral brain systems, CER, and suicide attempts are shown in Table 1.

Table 1. Mean, standard deviation, and the normality assumption of data using skewness and kurtosis statistics.

Variable	M	SD	Skewness	Kurtosis
Suicide attempt	24.3	7.42	-0.163	-0.984
Adaptive regulation	53.2	10.5	-0.822	0.483
Maladaptive regulation	63.2	13.5	-0.180	-0.711
Behavioral inhibition	24.5	3.85	-0.222	-0.556
Behavioral activation	42.1	10.3	-0.280	-0.391

Table 1 presents the research variables' average, standard deviation, and normality assumptions. The normality assumption of the data was checked based on Klein's (16) viewpoint based on skewness and kurtosis statistics (Table 1). The box diagram results showed that 194 of the 200 collected data points were included in the analysis. Linear relationships between variables were confirmed using scatter plots. Tolerance statistics and variance inflation factors (VIF) were used to check multiple collinearities, which were not smaller than 0.1 and larger than 10 for none

of the variables. The Durbin-Watson (DW) test results were between -2 and +2, so the data independence assumption is adequately met.

Table 2. The correlation coefficient matrix of the research variables

Row	Variables	1	2	3	5	6
1	Inhibition	-				
2	Activation	0.091	-			
3	Adaptive	-0.067	**0.77	-		
			1			
4	Maladaptive	**0.44	**_	0.07		
	ve	6	0.225	6		
5	Suicide attempts	**0.32	**_	0.33	**0.71	-
		4	0.522	2	3	

**P < 0.001

The proposed model had a good fit with the data. As can be seen, the chi-square (χ^2)

These results show that CER of BIS/BAS and maladaptive CER are positively and directly correlated with suicide attempts.

Table 4 presents indirect effects, The results of this model showed that 27% of the

value in the final verified model has become significant. Since this index, in large samples, is usually significant, it cannot be a reliable criterion to check the fit of the proposed model with the data. In addition, the values of other fit indices are as follows: the ratio of chi-square to the degree of freedom (df/χ^2) is 1.67, incremental fit index (IFI) is 0.99, comparative fit index (CFI) is 0.99, goodness of fit index (GFI) is 0.99, normalized fit index or Tucker-Lewis index (NNFI) is 0.99, adjusted goodness of fit index (AGFI) is 0.98, normalized fit index (NFI) is 0.99, and the root mean square error of approximation (RMSEA) is 0.05, which indicates a good fit of the final verified model with the data

variance of maladaptive CER and 61% of the variance of adaptive CER is explained by BAS/BIS systems. In addition, 65% of the suicide attempt variance is explained by BAS/BIS systems and adaptive and maladaptive CER (Figure 2).

Table 3. The direct path coefficients of the research variables

Dependent variable	β	SE	CR	P
Inhibition $\rightarrow$ adaptive CER	-0.138	0.099	-3.070	P = 0.002
Activation $\rightarrow$ adaptive CER	0.784	0.044	17.456	P < 0.001
Inhibition $\rightarrow$ maladaptive CER	0.470	0.192	7.604	P < 0.001
Activation $\rightarrow$ maladaptive CER	-0.267	0.0087	-4.327	P < 0.001
Activation $\rightarrow$ suicide attempt	-0.475	0.057	-6.803	P < 0.001
Inhibition $\rightarrow$ suicide attempt	0.125	0.090	2.524	P > 0.05
Adaptive CER $\rightarrow$ suicide attempt	0.083	0.056	1.209	P = 0.227
Maladaptive CER $\rightarrow$ suicide attempt	0.562	0.029	11.309	P < 0.001

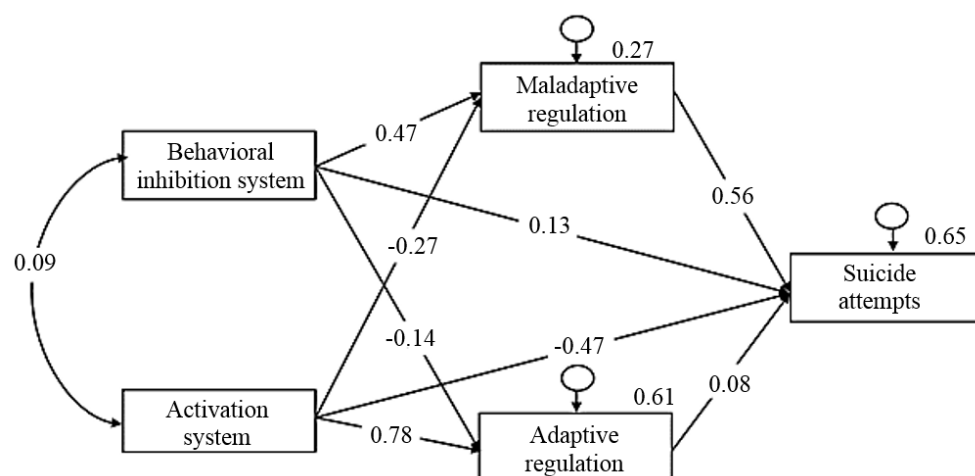


Figure 2. The confirmed and final model of the research

Table 4. The Bootstrap results of the indirect effect of BIS/BAS with suicide attempts through adaptive and maladaptive CER

Variable	Indirect effect	Bias	LL	UL	S.E	P
Activation → maladaptive CER → suicide	-0.154	-0.002	-0.207	-0.110	0.030	P < 0.001
Inhibition → maladaptive CER → suicide	0.271	0.001	0.199	0.338	0.042	P < 0.001
Activation → adaptive CER → suicide	0.248	0.001	0.360	0.134	0.069	P < 0.001
Inhibition → adaptive CER → suicide	-0.044	-0.003	-0.020	-0.075	0.017	P < 0.001

Discussion

This research aimed to investigate the relationship between BAS/BIS systems and suicide attempts with the mediating role of CER strategies in adolescents. The results of structural equation modeling showed that the BAS/BIS systems directly affect the suicide attempt. In addition, BAS has an indirect and positive effect through adaptive CER and an indirect and negative effect through maladaptive CER on suicide attempts. Moreover, BIS has an indirect and negative effect through adaptive CER and an indirect and positive effect through adaptive CER on suicide attempts. These findings are consistent with the results of other research, e.g., Khosravani et al. (23), and Bryan et al. (15), in which BAS/BIS systems are correlated with adolescents' suicide attempts and ideation.

The result of this hypothesis can be explained based on the theory of reward sensitivity, which states that self-harm behaviors and suicide attempts are two mechanisms of BIS. First, the excessive sensitivity of some areas, except for the parietal-hippocampal system, increases the intrinsic destructive input of disgust and vulnerability. Second, the overactivity of the parietal-hippocampal system or the overactivity of the amygdala areas, which are connected to this system, excessively increases the threatening evaluations of environmental stimuli and, consequently, magnifies the evaluation of risk and increases negative evaluation and associations of the situation (24). In addition, these results are consistent with the findings of Khosravani et al. (23) in which high BIS sensitivity, regardless of

the nature of the stressful event, is associated with unpleasant emotions. Regardless of the situation, people with high levels of BIS experience more unpleasant emotions in general, and they experience a greater increase in their unpleasant emotions in stressful situations (e.g., situations provoking anger, fear, anxiety, and depression). These unpleasant (negative) emotions cause people to use a set of ineffective emotional strategies (e.g., self-blame, self-judgment, blame others, ruminating, and catastrophizing). For example, they constantly think about future events and judge their thoughts somehow, which hinders the awareness and acceptance of excitement. In addition, these people engage with the anxiety-provoking content of their thoughts, which prevents reevaluation of the situation from positive or safe perspectives (25).

The results of structural equation modeling showed that maladaptive CER directly and positively affects suicide attempts. In addition, the direct path coefficient of adaptive CER to suicide attempt was not significant. These findings are consistent with the results of Rajapa et al (26), Wong and Chung (11) that maladaptive CER is related to adolescent ideation and suicide attempts.

To justify these results, one can say that emotion regulation refers to a person's ability to understand and accept his feelings, and the use of appropriate management strategies for unpleasant emotions results from inability and the lack of capabilities for emotion regulation. Emotion regulation is very important for people's adaptation to stressful life events

(27). In other words, experiencing negative emotions in life is inevitable, so there is considerable potential for experiencing difficulty regulating emotions. As a result, an individual's incorrect cognitive and emotional assessment of stressful situations, due to the lack of information, evaluation, wrong perception and interpretation, or illogical and incorrect assumptions and beliefs, cause an individual to choose the wrong coping emotional strategy to face those situations. The choice of an ineffective emotional coping strategy and self-disability in cognitive, emotional, and behavioral dimensions increases the possibility of choosing maladaptive and non-beneficial emotional coping strategies and negatively affects mental health and psychological well-being. This viewpoint indicates that insufficient emotional development, difficulty in organizing behavior and emotions, and having negative emotions cause feelings and emotions to prevail over logic and reasoning so that individuals in different conditions and situations may make her/his decisions only based on emotional atmosphere and environmental factors and fail to consider possible logical solutions. Accordingly, Gross (28) considers the use of maladaptive and ineffective strategies of emotional regulation and the lack of proper ability to regulate emotions as important possible factors underlying the risk of mental disorders and suicide attempts. In addition, the low levels of adaptive emotion regulation strategies, ineffectiveness in controlling emotions, and inability to effectively deal with emotions and manage them have an essential role in creating externalized problems and disorders such as anger, self-mutilation, and suicide attempts (29).

This research had limitations that should be taken into account in the case of generalizing the results. The research covers the high school students of Abyek City in the 2022-2023 academic year, and it does not consider gender differences, so

caution should be exercised in the case of generalizing its results to other times and geographical areas. Another limitation is the use of a questionnaire as a self-report tool because, in self-report instruments, participants may distort their answers due to conscious or unconscious social desirability bias. Therefore, it is recommended that the findings be generalized with caution. Since it is descriptive correlational research, causal interpretations similar to experimental research should not be made based on the findings. In order to increase the emotional regulation of students in critical situations, it suggests implementing and operationalizing training workshops and empowerment courses to increase CER strategies and resiliency and reduce students' tendencies to suicide. To reduce suicide attempts in students, it is also suggested that counseling centers and psychological services in their training and treatment centers for students include preventive programs in terms of crisis intervention, skill training, and character empowerment to prevent suicide. Finally, future research is suggested to formulate a structural model based on protective and risk factors in suicide attempts in students and investigate the explanatory role of each factor in CER.

Authors' contribution

The only one author, MEM, developed all parts of the study.

Ethical considerations

For ethical considerations, the principles of the Declaration of Helsinki were followed at the time of study.

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Conflicts of interest

The author declare that she has no known competing interests or personal

relationships that could have appeared to influence the work reported in this paper.

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