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The Relationship between the Implicit Self-Esteem, the Behavioral Activation and Inhibition Systems (BAS/BIS), and Narcissistic Traits in Students

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Abstract

Background & Objectives: Narcissistic personality traits are shaped by multiple cognitive and behavioral processes. This study investigated the extent to which implicit self-esteem and the behavioral activation and inhibition systems (BAS/BIS) predict narcissistic personality traits in students.

Materials & Methods: This descriptive correlational study included 295 students who were selected by simple random sampling. Participants completed the Dirty Dozen Narcissistic Personality Questionnaire, the Gray-Wilson Personality Questionnaire, and the Implicit Association Test for self-esteem. Relationships among variables were examined using correlation and multiple regression analyses to determine the variance in narcissistic traits.

Results: Results revealed significant correlations between narcissistic personality traits and implicit self-esteem ($r = -0.48$), the behavioral inhibition system ($r = -0.53$), and the behavioral activation system ($r = 0.82$). Multiple regression analysis indicated that implicit self-esteem and the behavioral systems together accounted for 74% of the variance in narcissistic traits. Although this R^2 is large, it is atypical in behavioral research and therefore warrants replication to rule out overfitting.

Conclusion: These findings underscore the roles of implicit self-esteem and reinforcement sensitivity in shaping narcissistic traits and offer guidance for psychologists and counselors developing culturally informed preventive and therapeutic interventions for students.

Keywords: Narcissistic traits, implicit self-esteem, behavioral activation system, behavioral inhibition system, students

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Introduction

Entering university constitutes a significant transition into adulthood, during which students encounter a range of stressors and emotional challenges, including demanding academic expectations, shifts in family roles, the redefinition of social relationships, and interactions with individuals who hold diverse values and lifestyles (1). These structural changes in an individual's life can increase the likelihood of developing specific personality constructs, potentially leading to the emergence or intensification of traits that affect not only academic performance but also interpersonal relations and social adjustment (2). Among the phenomena that have attracted particular attention in student populations in recent years is the rise of narcissistic personality traits, which are characterized by a sense of entitlement, a persistent need for admiration, the exploitation of

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others, and a pronounced desire for attention (3).

Narcissism is a multidimensional construct that manifests in a variety of behavioral and emotional patterns, such as grandiose, amorous, unethical, and compensatory narcissism (4). Individuals with narcissistic traits frequently endorse grandiose beliefs about their abilities and importance, regarding attention and admiration from others as their rightful due, while exhibiting difficulties in emotional understanding and empathic concern for others. Kowalski has described this construct as one of the most disruptive personality patterns, placing it at the core of the dark triad of personality (5). In other words, narcissism is not merely an individual characteristic but has substantial social consequences and can lead to violations of normative behavior in interpersonal contexts (6, 7).

The persistent expression of these traits may result in disrupted interpersonal relationships and elevated conflict with peers, family members, and fellow students. Indeed, several studies indicate that heightened narcissistic behaviors during the university years are associated with increased levels of depression and, in some cases, suicidal ideation (8, 9). Notably, recent research has shifted emphasis from overt, self-reported indicators of narcissism to its implicit and underlying components. Among these, implicit self-esteem has emerged as a central construct for explaining narcissistic behaviors, playing a critical role in compensatory and reward-driven actions (10, 11).

A substantial body of work demonstrates that individuals with narcissistic personalities often exhibit a discrepancy between explicit and implicit self-esteem, presenting themselves as highly self-regardingly on a conscious level while experiencing low self-esteem at an implicit level (12, 13). Marissen and colleagues' findings further indicate that the gap between implicit and explicit self-esteem is significantly larger in individuals with narcissistic traits than in healthy comparison groups (14). These results suggest that implicit self-esteem may function as a meaningful predictor of the severity and form of narcissism.

Within this context, brain–behavioral system theories have been proposed as a biological framework for understanding narcissistic behaviors. According to Gray's Reinforcement Sensitivity Theory, two primary systems—the Behavioral Activation System (BAS) and the Behavioral Inhibition System (BIS)—are engaged in response to reward and punishment cues, respectively (15, 16). BAS is associated with dopaminergic reward circuits, particularly within the ventral striatum and prefrontal cortex, and promotes reward-seeking behaviors, whereas BIS is linked to amygdala–prefrontal interactions and modulates anxiety and avoidance responses (17, 18). Luthans argues that narcissism is associated with heightened BAS activity because its characteristic features—seeking attention, craving admiration, and striving for prominence—are embedded in reward-driven behavior (19). Findings from Javidfar (20) and McLaren (21) likewise demonstrate a positive relationship between BAS and narcissism, while BIS tends to correlate negatively with this construct. Conversely, some studies suggest that vulnerable forms of narcissism may be associated with BIS activation and avoidance tendencies (22).

This neuropsychological model, which incorporates three systems (BAS, BIS, and FFS), provides a comprehensive framework for understanding individual differences in emotion regulation and responses to environmental stimuli (23, 24). For example, individuals with high BAS activity frequently seek external stimulation and display more emotionally driven behavior, whereas those with elevated BIS activity tend to exhibit caution, enhanced self-control, and avoidance responses. Evidence concerning the FFS indicates that it is principally activated in acute, threatening situations and is less consistently associated with stable

personality traits (25). Recent neuroimaging studies further corroborate these associations, showing that BAS-driven behaviors correspond with increased activation in the nucleus accumbens and orbitofrontal cortex, whereas BIS activation is related to heightened amygdala responses to threat cues (26, 27).

In addition to biological explanations, psychoanalytic perspectives offer further insight into narcissistic phenomena. From Kohut's viewpoint, narcissistic behaviors may function as defensive strategies for a fragile or vulnerable self, serving as self-regulatory mechanisms that compensate for early deficits in parent–child relationships (28). Consequently, under psychological stress, individuals with fragile self-regard are more likely than others to seek external validation and attention. Concurrent examination of implicit self-esteem and brain–behavioral system activity can help elucidate the mechanisms that underlie these responses and assist in discriminating among subtypes of narcissism.

Moreover, in the academic context—where individuals from diverse cultural and social backgrounds converge—social interactions become more complex, and academic competition may reinforce reward-driven behavior. The cultural milieu of Iranian universities, which is characterized by collectivist values and hierarchical social structures, may amplify narcissistic tendencies among students who strive for social prominence within a competitive academic environment (29). In such contexts, the prevalence of narcissistic behaviors may increase, making the identification of individual factors such as implicit self-esteem and reinforcement sensitivity particularly valuable for designing targeted psychological interventions (30). Research indicates that higher levels of narcissism are associated with greater aggression, emotional instability, and engagement in risky behaviors among students (31). Therefore, focusing on underlying factors such as implicit self-esteem and BAS/BIS activity can inform preventive strategies and university policymaking (15, 16).

Given the theoretical and practical significance of these variables, investigating the combined role of implicit self-esteem and brain–behavioral systems in shaping narcissistic traits constitutes an innovative approach in psychological research. Importantly, to our knowledge, no prior study has examined the combined contribution of implicit self-esteem and BAS/BIS in predicting narcissistic traits among students, and this absence represents a key research gap that the present study addresses. Such work enhances our understanding of the processes that underlie narcissism and facilitates the development of interventions aimed at fostering authentic self-esteem—thereby reducing the discrepancy between explicit and implicit self-evaluations—and at modulating reinforcement sensitivity. Because this study uses a correlational design, causal inferences are limited; the findings therefore reflect associations rather than causation, and future experimental or longitudinal research is needed to clarify directional relationships (32).

Accordingly, this study was undertaken to examine the relationship between implicit self-esteem and the BAS/BIS in predicting narcissistic personality traits among students. A precise understanding of the interplay among these variables can, at a theoretical level, advance our comprehension of dark personality dimensions and, at a practical level, provide effective strategies for the development of prevention, screening, and psychological intervention programs within university settings (33).

Materials and Methods

This study employed a descriptive correlational design to examine the role of implicit self-esteem and brain–behavioral systems in predicting narcissistic personality traits. The target population comprised all students enrolled at Islamic Azad University,

Khoy Branch, during the 2023–2024 academic year. The sample size was determined according to the Krejcie and Morgan table, and 295 participants were selected via simple random sampling. All procedures complied with ethical research principles, participant confidentiality was ensured, and the study received ethical approval (IR.IAU.TABRIZ.REC.1403.455) from the Ethics Committee of the Tabriz Branch of Medical Sciences, Islamic Azad University.

Data Collection Tools

The selection of measurement instruments was guided by their established psychometric validity and relevance to the study objectives, though certain limitations in their scope and reliability were acknowledged.

1. Dirty Dozen Scale (Dark Triad Personality): This 12-item scale, developed by Jonason and Webster (34)**,** was employed to assess narcissistic personality traits. Items were rated on a **9-**point Likert scale ranging from 1 (strongly disagree) to 9 (strongly agree). The scale comprises three dimensions: *narcissism* (items 9–12), *psychopathy* (items 5–8), and *Machiavellianism* (items 1–4). Scores for each dimension were obtained by summing the corresponding items, with higher scores reflecting greater intensity of each respective trait. The overall reliability of the scale and its dimensions, as assessed through test-retest reliability, was reported as 0.89, 0.87, 0.76, and 0.86, respectively. Within the Iranian context, Cronbach's alpha coefficients were 0.79, 0.83, and 0.81 (35). The Dirty Dozen was chosen for its brevity, efficiency, and validated application in assessing Dark Triad traits across diverse populations. However, its concise structure may limit its capacity to capture the full spectrum of narcissistic characteristics, particularly vulnerable narcissism**.** Future investigations may benefit from complementing this tool with more comprehensive instruments, such as the Narcissistic Personality Inventory (NPI) or the Five-Factor Narcissism Inventory (FFNI), to yield a more nuanced and multidimensional assessment (36).

2. Gray-Wilson Personality Questionnaire: This 120-item questionnaire was used to evaluate the activity of brain-behavioral systems and their subcomponents, including the *Behavioral Inhibition System (BIS)*, *Behavioral Activation System (BAS)*, and *Fight-Flight System (FFS)*. Each system encompasses two components, with 20 items allocated to each: the BAS includes *approach* and *active avoidance*, the BIS encompasses *passive avoidance* and *extinction*, and the FFS comprises *fight* and *flight*. The reliability of the subcomponents, measured via Cronbach's alpha, ranged from 0.58 to 0.75, while convergent validity was confirmed against the *Eysenck Personality Questionnaire (EPQ)* (37).

3. Implicit Association Test (IAT) for Self-Esteem: This computer-based test, developed by Greenwald et al. (38)**,** measures reaction times in categorizing self-related and non-self-related stimuli in response to *positive* and *negative* cues. Faster classification of positive self-related stimuli indicates stronger implicit self-esteem**.** The test consists of seven stages, and the Persian version demonstrated an internal reliability of 0.63 and a test-retest reliability of 0.52 **(**39). The IAT was selected due to its ability to assess non-conscious aspects of self-esteem**,** a critical factor in understanding implicit processes underlying narcissism**.** Nevertheless, its moderate reliability suggests potential variability in measurement**,** and future studies could integrate additional implicit measures, such as the Name-Letter Test, to enhance overall reliability (40).

Data Analysis

Data were analyzed using Pearson's correlation coefficient to examine the relationships among the study variables and multiple regression analysis to determine the predictive effects of implicit self-esteem and brain-behavioral systems on narcissistic traits**.** Data normality was verified using the Kolmogorov–Smirnov test, while homogeneity of variances was assessed through

Levene's test (Table 1). Additionally, Pearson's correlations and corresponding effect sizes are presented in Table 2. To address potential multicollinearity, Variance Inflation Factors (VIFs) were computed for all predictors, with values below 5 indicating acceptable levels (Table 3). However, the high explained variance (R^2 = 0.74) raised concerns regarding possible model overfitting, which was further evaluated through cross-validation procedures during data analysis. The significance threshold for all tests was set at $p < 0.05$. All analyses were conducted using SPSS version 26, and results were reported in terms of means, standard deviations, correlation coefficients, and coefficients of determination (R^2).

Results

Descriptive Statistics and Normality Assessment

The mean age of participants was 22.47 years. Of the total sample, 56.6% were male and 43.4% were female. As presented in Table 1, the means and standard deviations of the study variables are as follows:

As shown in Table 1, the means and standard deviations of the study variables are as follows: Narcissistic personality (M = 16.43, SD = 5.91), implicit self-esteem (M = 1.28, SD = 0.45), BAS (M = 19.90, SD = 9.03), BIS (M = 20.59, SD = 9.29), and Fight-Flight System (FFS) (M = 14.44, SD = 3.08). The Kolmogorov–Smirnov test indicated that the distributions of all variables did not deviate significantly from normality ($P > 0.05$).

Pearson Correlation Matrix

The results reported in Table 2 revealed a significant negative correlation between narcissistic personality and implicit self-esteem ($r = -0.48$, $p < 0.01$). In addition, narcissistic personality correlated strongly and positively

Table 1. Descriptive Statistics and Kolmogorov-Smirnov Test

Variable	Component	Min	Max	Mean	SD	K-S Statistic	p
Narcissistic Traits	-	10	32	16.43	5.91	0.519	0.402
Implicit Self-Esteem	-	1	2	1.28	0.45	0.801	0.727
Brain-Behavioral Systems	BAS	10	39	19.90	9.03	0.881	0.811
	BIS	7	37	20.59	9.29	0.309	0.282
	FFS	5	28	14.44	3.08	0.529	0.418

Table 2. Pearson Correlations and Effect Sizes

Variable	Narcissistic Traits	Implicit Self-Esteem	BAS	BIS	FFS
Narcissistic Traits	1	-0.48** (r^2=0.23)	0.82** (r^2=0.67)	-0.53** (r^2=0.28)	0.07 (r^2=0.005)
Implicit Self-Esteem		1	-0.37** (r^2=0.14)	-0.34** (r^2=0.12)	0.03 (r^2=0.001)
BAS			1	-0.41** (r^2=0.17)	0.06 (r^2=0.004)
BIS				1	0.05 (r^2=0.003)
FFS					1

**p<0.01

Table 3. Multiple Regression for Predicting Narcissistic Traits

Predictor	B	SE	β	t	p	VIF
Implicit Self-Esteem	-2.07	0.429	-0.16	-4.84	<0.001	2.1
BAS	0.45	0.022	0.68	20.40	<0.001	4.2
BIS	-0.12	0.021	-0.19	-5.86	<0.001	3.8
FFS	0.025	0.057	0.01	0.439	0.661	1.9

R^2=0.74, F (4,290) =215.59, p<0.001

with the BAS ($r = 0.82$, $p < 0.01$) and significantly and negatively with the BIS ($r = -0.53$, $p < 0.01$). No significant relationship was observed between narcissistic personality and the FFS ($r = 0.07$, $p =$ ns).

Multiple Regression Analysis

As shown in Table 3, implicit self-esteem and the brain-behavioral systems together accounted for 74% of the variance in narcissistic personality traits ($R^2 = 0.74$, $p < 0.001$). Given that such a high R^2 is uncommon in personality research, where predictive R^2 values typically range from approximately 0.10 to 0.30, this result may reflect shared method variance among self-report instruments or potential model overfitting despite acceptable multicollinearity (VIF < 5). To evaluate model robustness, we performed a sensitivity analysis using bootstrapping with 1,000 resamples and split-sample validation based on a random 70/30 split. Bootstrapped 95% confidence intervals for the β coefficients remained significant (for example, BAS: 95% CI [0.62, 0.74]), and the R^2 in the validation subsample was 0.71, indicating reasonable stability while underscoring the necessity of replication in independent samples. In the regression model, implicit self-esteem ($\beta = -0.16$, $p < 0.0001$) and the BIS ($\beta = -0.19$, $p < 0.0001$) were significant negative predictors of narcissistic personality, whereas the BAS was a significant positive predictor ($\beta = 0.68$, $p < 0.0001$). The FFS did not predict narcissistic personality significantly ($\beta = 0.01$, $p = 0.661$).

Discussion

The aim of this study was to examine the roles of implicit self-esteem and the BAS/BIS in predicting narcissistic personality traits among university students. The results indicated that narcissistic personality traits were negatively associated with implicit self-esteem and the BIS and positively associated with the BAS. Moreover, implicit self-esteem and the brain-behavioral systems together accounted for 74% of the variance in students' narcissistic personality traits, with implicit self-esteem and BIS exerting significant negative predictive effects and BAS exerting a significant positive predictive effect, while the FFS did not demonstrate a significant predictive role. This unusually high R^2 is atypical in psychological research and may reflect shared method variance attributable to self-report instruments or potential model overfitting despite acceptable VIF values (< 5). To examine model robustness, we performed sensitivity analyses using bootstrapping (1,000 resamples) and split-sample validation (random 70/30 split); bootstrapped confidence intervals for the β coefficients remained significant (for example, BAS: 95% CI [0.62, 0.74]) and the R^2 in the validation subsample was 0.71, indicating relative stability while underscoring the need for replication in independent samples.

The present findings regarding implicit self-esteem are consistent with prior research suggesting that implicit self-esteem is associated with narcissistic behaviors and tendencies (4, 10, 11). For example, Imran and colleagues reported a significant relationship between self-esteem and narcissistic behavioral manifestations such as frequent selfie-taking (11), and Son likewise documented a significant correlation between self-esteem and narcissistic personality features (12). Marissen and colleagues further observed a significant association between implicit and explicit self-esteem and narcissistic traits, reporting that individuals with narcissistic profiles may display elevated implicit self-esteem (13).

These results imply that students who exhibit narcissistic personality characteristics tend to show behavioral patterns marked by pronounced self-importance, a persistent need for admiration, and diminished empathy for others' emotions; accordingly, narcissistic personality may be conceptualized as a form of inflated self-esteem. From the vantage point of social learning theory, elevated implicit self-esteem functions as a characteristic marker

of narcissistic personality, and some theorists characterize narcissism as an emotional investment in establishing personal superiority although the narcissistic individual may still feel that such superiority remains unrealized (14). Consistent with Kohut's formulations, individuals with narcissistic personality organization often display overt grandiosity and fantasies of unlimited success that mask an underlying fragile self-esteem; implicit self-esteem in such individuals therefore operates automatically and unconsciously (28). Kohut posited that the early self is shaped by two core narcissistic needs: the exhibition of a grandiose self and the internalization of an idealized parental image; when these self-representations persist without being accompanied by authentic self-esteem, they may culminate in pathological narcissistic functioning in adulthood (28).

Findings concerning the BAS/BIS accord with studies that conceptualize narcissism as a self-regulatory pattern oriented toward reward sensitivity and concomitant avoidance of punishment cues (15, 16). Neuroimaging evidence supports these associations: BAS has been linked to increased activity in dopaminergic reward circuits such as the ventral striatum and orbitofrontal cortex, which underpin reward-seeking behaviors characteristic of grandiose narcissism, whereas BIS has been associated with amygdala–prefrontal connectivity implicated in avoidance and anxiety responses that are often related to vulnerable narcissism (17, 26). Luthans reported that narcissistic tendencies align with BAS-driven, reward-oriented behaviors such as an excessive pursuit of admiration (18, 19), and research by Javidfar and McLaren similarly documented positive associations between narcissism and BAS and negative associations with BIS (20, 21). Spencer and colleagues further distinguished grandiose narcissism as BAS-related and vulnerable narcissism as BIS-related (22).

These observations are consistent with Gray's Reinforcement Sensitivity Theory, which explains interindividual differences in sensitivity to environmental rewards and punishments in terms of three systems: BAS, BIS, and the FFS (20). Brain-behavioral systems map onto positive and negative affect and reflect approach or avoidance tendencies that are integral to the functioning of narcissistic personality. Empirical evidence suggests that emotional instability and negative affect contribute to narcissistic manifestations, while narcissism is positively associated with traits such as emotional indifference, callousness, and aggression (22). Individuals with narcissistic traits—driven by a chronic need for admiration, praise, and attention—tend to display more emotionally expressive and extraverted behaviors, which may arise from an imbalance between BAS and BIS. Krupić demonstrated that elevated BAS combined with reduced BIS in individuals with inflated self-confidence is related to greater risk-taking and behavioral errors, thereby highlighting the substantive role of these systems in narcissistic pathology (41).

Although the regression model's high explained variance ($R^2 = 0.74$) suggests a strong relationship between the predictors and narcissistic traits, it also raises concerns about potential overfitting, particularly given moderate intercorrelations among predictors (for example, BAS and BIS, $r = -0.41$). Reported VIFs (Table 3; all < 5) indicate acceptable multicollinearity, yet the model's generalizability remains uncertain and warrants replication across more diverse samples. Cross-validation procedures employed in the present analyses provided preliminary evidence of stability, but future investigations should routinely implement resampling techniques such as bootstrapping, k-fold cross-validation, or external split-sample validation to confirm the robustness of these findings (42).

It is important to emphasize that the correlational design of this study precludes causal inference. Although strong associations emerged among implicit self-esteem, BAS/BIS,

and narcissistic traits, the directionality of these relationships remains unresolved; it is unclear whether diminished implicit self-esteem fosters narcissistic tendencies or whether narcissistic dispositions alter implicit self-evaluations. Longitudinal or experimental research designs are therefore necessary to disentangle temporal and causal relations (32).

Several limitations temper the interpretation of our results. First, the sample was drawn from a single Iranian university, which restricts the external validity of the findings; Iran's collectivist cultural norms that emphasize group harmony and social hierarchy may shape the expression of narcissistic traits differently than individualistic cultures in which self-promotion is more normative (43). For example, grandiose narcissism in collectivist settings may be expressed through the pursuit of social status, whereas vulnerable narcissism may be more prevalent in contexts that prize individual achievement. Future research should therefore include cross-cultural samples to elucidate cultural moderators of narcissistic expression and to enhance the generalizability of conclusions (44).

Notwithstanding these limitations, this study is, to our knowledge, the first to examine simultaneously the predictive contributions of implicit self-esteem and the BAS/BIS to narcissistic personality among students. This integrative approach advances understanding of the mechanisms that underlie narcissistic functioning and may inform the development of targeted educational and clinical interventions aimed at mitigating maladaptive narcissistic behaviors in university settings.

Conclusion

Overall, the findings underscore the importance for psychologists and university counselors of understanding how implicit self-esteem and the BAS/BIS contribute to narcissistic personality traits among students. On the basis of these results, practitioners can raise awareness of narcissistic traits and their antecedents through psychoeducational programs, environmental-awareness initiatives, and therapeutic workshops, thereby facilitating more accurate recognition and timely intervention. Moreover, conducting prevalence studies, implementing routine screening, and identifying students at elevated risk for narcissistic personality–related difficulties can provide a foundation for preventive efforts that mitigate the development and escalation of symptoms and reduce consequent psychological and social harm.

This study has several limitations that should temper interpretation of the results. First, the use of the Dirty Dozen scale, while pragmatic because of its brevity, may not capture the multidimensional nature of narcissism, especially vulnerable narcissism. Second, the moderate reliability of the IAT for self-esteem (Cronbach's alpha = 0.63) indicates potential measurement variability. Future research should therefore incorporate complementary instruments—such as the NPI or the Name-Letter Test—to strengthen measurement robustness (45, 46). Third, the high explained variance ($R^2 = 0.74$) raises the possibility of model overfitting and underscores the necessity of replication in larger and more diverse samples. Fourth, the study's restriction to students from a single Iranian university and the exclusive reliance on self-report measures limit external validity; cultural factors associated with collectivism may shape the manifestation of narcissistic traits in ways that differ from individualistic societies (43). Consequently, caution is warranted when generalizing these findings beyond the present sample. To enhance validity and reliability, future studies should employ complementary data-collection methods such as structured interviews and behavioral observations and examine potential mediators and moderators (for example, cultural values or parenting styles) as well as longitudinal trajectories of narcissistic personality (44).

The present results have practical implications for the development of targeted educational and intervention programs within university settings. Training that emphasizes empathy, emotion regulation, and interpersonal skills may empower students to regulate narcissistic tendencies and foster healthier, more stable relationships. Furthermore, these findings can inform preventive policies and clinical interventions aimed at reducing the adverse academic and social consequences of maladaptive narcissistic behaviors.

Given the present findings and limitations, future research should investigate additional psychological constructs related to narcissism—such as attachment styles, early maladaptive schemas, and broader personality traits—to produce a more comprehensive account of narcissistic functioning and to inform more effective prevention, intervention, and treatment strategies. Ultimately, a deeper elucidation of the mechanisms that underlie narcissism and their interplay with related psychological variables can contribute to improvements in students' mental health and interpersonal functioning.

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Conflict of Interest

The authors declare that they have no conflicts of interest.

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Code of Ethics

IR.IAU.TABRIZ.REC.1403.455

Ethical Considerations

This study was conducted in accordance with the ethical principles set forth in the Declaration of Helsinki and was approved by the Ethics Committee of the Tabriz Branch of Medical Sciences, Islamic Azad University.

Authors Contributions

This article is derived from the Master's thesis of the first author, Naser Herfedoost. So Naser Herfedoost: Conceptualization, formal analysis, investigation (data collection), writing—original draft and preparation. Seyed Mahmoud Tabatabaei: Validation, supervision, writing—review and editing, and project administration. All authors have read and agreed to the published version of the manuscript.

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