

Predicting Quality of Life Based on Social Cognition with the Mediating Role of Emotion Regulation in Patients with Traumatic Brain Injury

Hadis. Jafari¹, Afsaneh. Taheri^{1*}, Hamidreza. Khayat Kashani²

1 Department of psychology, Ro.C., Islamic Azad University, Roudehen, Iran.

2 Department of Neurosurgery, School of Medicine, Shahid Beheshti University of Medical Sciences, Tehran, Iran.

*Correspondence: a_taheri@iau.ac.ir

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ABSTRACT

The present study aimed to predict quality of life based on social cognition and to examine the mediating role of emotion regulation in patients with traumatic brain injury. This descriptive-correlational study was conducted using structural equation modeling. The statistical population consisted of patients with traumatic brain injury referred to Imam Hossein Hospital in Tehran, Iran, during 2024–2025. A total of 300 patients were selected through convenience sampling. Data were collected using the World Health Organization Quality of Life-BREF questionnaire, the Reading the Mind in the Eyes Test, and the Emotion Regulation Questionnaire. Data were analyzed using Pearson correlation coefficients and structural equation modeling. Model fit was evaluated using χ^2/df , IFI, CFI, NFI, GFI, RMSEA, and SRMR indices, and the significance of indirect effects was examined using bootstrap analysis. Social cognition was significantly and positively correlated with emotion regulation ($r = 0.560$, $p < 0.01$) and quality of life ($r = 0.550$, $p < 0.01$), and emotion regulation was significantly and positively correlated with quality of life ($r = 0.583$, $p < 0.01$). The structural model showed acceptable fit ($\chi^2/df = 3.042$, IFI = 0.922, CFI = 0.921, NFI = 0.908, GFI = 0.917, RMSEA = 0.071, SRMR = 0.059). Social cognition had a significant direct effect on quality of life ($B = 0.123$, $\beta = 0.279$, $t = 4.213$, $p < 0.01$). The indirect effect of social cognition on quality of life through emotion regulation was also significant ($B = 0.049$, $\beta = 0.110$, $p < 0.01$), indicating partial mediation. The findings indicate that social cognition is associated with better quality of life in patients with traumatic brain injury both directly and indirectly through emotion regulation. These results highlight emotion regulation as an important explanatory mechanism linking social-cognitive functioning to quality of life and support the inclusion of social-cognitive and emotion-regulation interventions in rehabilitation programs for patients with traumatic brain injury

Keywords: Traumatic brain injury; Quality of life; Social cognition; Emotion regulation; Structural equation modeling; Mediation

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Introduction

Traumatic brain injury (TBI) is a major neurological and public health problem that can produce persistent physical, cognitive, emotional, and social consequences long after the acute phase of injury has ended. TBI may result from falls, road traffic crashes, occupational incidents, sports injuries, interpersonal violence, and other external mechanical forces, and its clinical manifestations vary substantially depending on injury severity, location, mechanism, and individual characteristics. At the global level, the incidence of TBI is considerable, and the burden is especially important because many affected individuals are of working

age and may require prolonged medical, rehabilitation, psychological, and social support (1). Epidemiological evidence from Europe has likewise demonstrated that TBI represents a substantial source of morbidity and healthcare utilization, with important differences across age groups, countries, and mechanisms of injury (2). Contemporary approaches therefore increasingly emphasize TBI not as an isolated acute neurological event but as a chronic and multidimensional health condition requiring integrated prevention, emergency care, rehabilitation, and long-term follow-up (3). Recent efforts to standardize clinical management across hospital systems and trauma centers further reflect the continuing need to improve consistency of care, decision-making, and outcomes for individuals with brain injury (4, 5).

The consequences of TBI extend far beyond survival and the resolution of acute neurological symptoms. Even when patients demonstrate apparently satisfactory physical recovery, they may experience long-lasting impairments in cognition, emotional functioning, interpersonal behavior, community participation, employment, and family relationships. Such difficulties may persist for years and contribute to reduced independence and diminished subjective well-being. In addition, TBI can be accompanied by neurological complications that further complicate recovery and long-term functioning. For example, post-traumatic epilepsy remains an important consequence of TBI and may impose additional medical and psychosocial burdens on affected individuals (6). These long-term and interacting consequences have led researchers and clinicians to increasingly focus on quality of life as a central outcome of TBI rehabilitation, because conventional neurological or functional measures alone may not adequately capture how patients perceive their health, autonomy, social relationships, psychological state, and ability to participate meaningfully in everyday life.

Quality of life is a multidimensional construct incorporating physical health, psychological functioning, social relationships, environmental conditions, personal autonomy, and subjective evaluations of well-being. In the context of TBI, quality of life is particularly important because the effects of injury may extend across nearly every domain of everyday functioning. Research has shown that individuals with TBI may continue to report limitations in quality of life many years after the injury, indicating that the subjective burden of TBI can persist well beyond the period typically considered acute or subacute recovery (7). Research specifically focused on brain-injury-related quality of life has also emphasized the need for appropriate reference values and population-based comparisons to interpret patients' outcomes more meaningfully (8). Broader investigations of health-related quality of life after head injury have similarly highlighted the importance of examining both immediate and long-term consequences across different age groups and stages of recovery (9). In pediatric acquired brain injury, recent evidence has also shown that health-related quality of life may remain affected across multiple domains, demonstrating that the subjective consequences of brain injury are relevant throughout the lifespan (10). These findings collectively suggest that identifying psychological and neurocognitive factors associated with quality of life may provide clinically meaningful information for rehabilitation planning.

Among the factors that may influence adaptation after TBI, social cognition has received increasing attention. Social cognition refers to the set of mental processes involved in perceiving, interpreting, and responding to socially relevant information. It includes the ability to recognize emotions, understand the intentions and beliefs of others, interpret interpersonal cues, infer mental states, and adjust behavior according to social context. These capacities are essential for successful interpersonal relationships because

everyday social interactions require individuals to identify subtle emotional expressions, understand the perspectives of others, anticipate reactions, and modify their own behavior accordingly. Damage to neural systems involved in social information processing may therefore result in significant difficulties even when basic intellectual or language abilities remain relatively preserved.

Deficits in social cognition are frequently observed following TBI and can contribute to impaired social behavior, reduced interpersonal effectiveness, and difficulties reintegrating into family and community life. Research examining the relationship between social cognition and social behavior after TBI has shown that impairments in the interpretation of social and emotional information are meaningfully related to patients' everyday interpersonal functioning (11). Difficulties in empathy, emotional understanding, and recognition of others' internal states may also interfere with the maintenance of close relationships. For example, alexithymia and reduced emotional empathy have been documented following TBI, suggesting that altered processing of emotional information can affect both the identification of one's own emotional states and responsiveness to the emotions of others (12). Because social participation and interpersonal relationships represent important components of quality of life, impairment in social cognition may plausibly contribute to poorer subjective well-being after TBI.

The clinical importance of social cognition has also been recognized in the development of rehabilitation interventions. Programs targeting social cognition and emotion-related processes have been designed specifically for individuals with TBI, reflecting the view that difficulties in these domains are modifiable and clinically relevant rather than merely secondary consequences of injury. The T-ScEmo intervention, for example, was developed as a multifaceted treatment addressing social cognition and emotion regulation in patients with TBI and provides evidence that these constructs can be targeted together within rehabilitation (13). More recent rehabilitation technologies have similarly emphasized ecologically meaningful cognitive training, including digital and mobile approaches designed to improve attention and other cognitive processes required for successful daily functioning after TBI (14). Although attention training does not directly constitute social-cognitive rehabilitation, such developments reflect a broader shift toward interventions that aim to improve functional cognition in real-world contexts rather than focusing exclusively on laboratory-based performance.

One mechanism through which social cognition may be related to quality of life is emotion regulation. Emotion regulation refers to the processes by which individuals monitor, evaluate, and modify emotional responses in accordance with situational demands and personal goals. It includes both antecedent-focused strategies, such as cognitive reappraisal, and response-focused strategies, such as expressive suppression. Effective emotion regulation allows individuals to adjust the intensity, duration, and expression of emotional experiences, thereby supporting adaptive coping, interpersonal functioning, and psychological well-being. Conversely, emotion dysregulation may contribute to irritability, impulsive reactions, interpersonal conflict, anxiety, depressive symptoms, and difficulties in adapting to stressful life circumstances.

Following acquired brain injury, emotion regulation difficulties can become particularly prominent. The neural systems responsible for monitoring emotional responses and regulating behavior overlap substantially with regions that may be vulnerable to traumatic injury. Consequently, TBI can disrupt the ability to inhibit inappropriate emotional reactions, reinterpret distressing situations, tolerate frustration, and respond flexibly to interpersonal challenges. The need for valid assessment of these difficulties has led

to the development of measures specifically designed to evaluate emotional regulation after acquired brain injury (15). Evidence also indicates that emotion regulation after brain injury is associated with executive functioning in daily life as well as with symptoms of anxiety and depression, underscoring its relevance to both cognitive control and emotional adjustment (16). Thus, emotion regulation appears to represent a clinically meaningful bridge between neuropsychological impairment and broader psychosocial outcomes.

Emotion regulation may also have particular importance for quality of life because the subjective experience of health is strongly influenced by how individuals manage distress, frustration, interpersonal challenges, and changes in personal identity following injury. Patients with TBI often face repeated situations requiring emotional adaptation, including physical limitations, changes in occupational status, altered social roles, dependence on others, and uncertainty about recovery. Individuals who can reinterpret negative situations, regulate emotional reactions, and maintain flexible coping responses may be better able to preserve psychological well-being and social participation. In contrast, persistent suppression, poor emotional awareness, or uncontrolled emotional responses may amplify distress and reduce perceived quality of life. Studies outside the specific context of TBI also support the broader relevance of emotion regulation for social adaptation. For example, emotion regulation has been identified as an important predictor of social adjustment, suggesting that the ability to manage emotional experiences is closely connected to adaptive interpersonal functioning (17).

The relationship between social cognition and emotion regulation is theoretically important because successful emotional adjustment often depends on accurate interpretation of social information. Individuals must frequently recognize what others are feeling, understand the context of interpersonal events, distinguish threat from ambiguity, and anticipate the consequences of their responses before selecting an appropriate regulatory strategy. Impairment in social cognition may therefore limit the information available for effective emotion regulation. If a person misinterprets facial expressions, intentions, or interpersonal cues, the resulting emotional response may be poorly matched to the social context, making adaptive regulation more difficult. Conversely, effective regulation may allow individuals to use social-cognitive information more constructively by reducing excessive emotional arousal and improving behavioral control. The interaction between these processes is therefore likely to be bidirectional and clinically relevant.

Evidence from other psychiatric and neurological contexts provides further support for the interdependence of social cognition, emotion regulation, and social functioning. In depression, impaired social emotion regulation, social cognition, and interpersonal behavior have been conceptualized as interconnected mechanisms contributing to reduced social functioning and increased social costs (18). Although depression and TBI differ in etiology, this framework is relevant because many individuals with TBI also experience emotional symptoms that may interact with deficits in social information processing. Indeed, depression is a common and clinically important complication after TBI, and recent meta-analytic evidence has examined interventions such as non-invasive brain stimulation for depressive symptoms in this population (19). These findings reinforce the importance of considering emotional functioning as part of the broader rehabilitation process rather than treating it as independent from cognitive and social outcomes.

The processing of emotional facial information is especially relevant to the present conceptual framework because social cognition often depends on recognizing and interpreting emotional cues conveyed through

the face, particularly the eyes. Experimental neuroimaging research has shown that neural responses to emotional faces can vary as a function of physiological and psychological states, illustrating the sensitivity of emotion-processing systems to broader regulatory conditions (20). In individuals with TBI, difficulties in decoding such cues may create downstream problems in communication and emotional responding. A patient who cannot accurately infer whether another person is concerned, angry, fearful, disappointed, or supportive may be more likely to experience misunderstanding and conflict, which in turn may adversely affect social relationships and subjective quality of life. Accordingly, measures of theory of mind and emotion recognition may provide useful indicators of socially relevant cognitive functioning after brain injury.

Despite increasing recognition of social cognition and emotion regulation as important domains of TBI rehabilitation, these constructs are often studied separately. Many studies have focused on the prevalence and burden of TBI, neurological outcomes, quality of life, mood symptoms, or specific cognitive impairments, whereas comparatively fewer studies have examined an integrated explanatory pathway connecting social cognition, emotion regulation, and quality of life. This gap is important because a direct association between social cognition and quality of life may not fully explain how social-cognitive abilities are translated into everyday well-being. Emotion regulation may represent one of the mechanisms through which better social understanding contributes to improved adaptation. Individuals with stronger social cognition may interpret interpersonal situations more accurately, experience fewer misunderstandings, and select more contextually appropriate emotional responses. These processes may support better social relationships, psychological adjustment, and perceived quality of life. Conversely, impaired social cognition may contribute to maladaptive emotional responses, which may subsequently diminish well-being.

The possibility of a mediating role for emotion regulation is also supported by intervention research in TBI. The development of integrated treatments addressing both social cognition and emotion regulation suggests that these capacities are functionally interconnected and may jointly influence psychosocial outcomes (13). Moreover, the long-term nature of TBI-related quality-of-life impairment indicates that identifying modifiable psychological mechanisms may have substantial clinical value (7). Rehabilitation programs that focus only on physical recovery or isolated cognitive abilities may not sufficiently address the interpersonal and emotional difficulties that determine whether patients can successfully resume meaningful roles in family, occupational, and community settings. Consequently, examination of emotion regulation as a mediator may help clarify why social cognition is associated with quality of life and may identify a potentially modifiable mechanism for future intervention.

This issue is particularly important in clinical settings in which patients with TBI differ considerably in the extent of their recovery despite apparently similar neurological injury profiles. Advances in acute care and standardized trauma management have improved the consistency of early treatment, but variation in long-term psychosocial outcomes remains substantial (4, 5). The increasingly comprehensive view of TBI management therefore emphasizes not only survival and neurological stabilization but also rehabilitation, participation, emotional health, and social reintegration (3). Within this framework, social cognition and emotion regulation are particularly relevant because both affect how individuals understand their environment, respond to others, manage distress, and maintain relationships. Examining these variables together can therefore contribute to a more comprehensive understanding of quality of life following TBI and may inform more individualized rehabilitation strategies.

Accordingly, the aim of the present study was to predict quality of life based on social cognition and to examine the mediating role of emotion regulation in patients with traumatic brain injury.

Methods and Materials

Study Design and Participants

The present study employed a non-experimental, descriptive-correlational design and was conducted within the framework of structural equation modeling (SEM). This methodological approach was selected because the primary purpose of the study was to examine the structural relationships among social cognition, emotion regulation, and quality of life and, more specifically, to determine whether emotion regulation mediates the relationship between social cognition and quality of life among patients with traumatic brain injury (TBI). The statistical population consisted of all patients diagnosed with traumatic brain injury who were referred to Imam Hossein Hospital in Tehran, Iran, during 2024–2025. Considering the requirements of structural equation modeling and the need to obtain an adequate sample for estimating direct and indirect relationships among the study variables, the required sample size was initially estimated to range from approximately 180 to 540 participants. To ensure sufficient statistical power, improve the stability of parameter estimates, and compensate for the possible exclusion of incomplete questionnaires, a final sample of 300 patients was selected through convenience sampling from eligible individuals attending the hospital. Participants were recruited after confirming their willingness to participate and their ability to understand and respond to the study instruments. Participation was voluntary, and respondents were informed about the general objectives of the study and the confidentiality of their information before completing the measures. The principal variables included quality of life as the endogenous outcome variable, social cognition as the principal predictor variable, and emotion regulation as the proposed mediating variable. Social cognition was operationalized through performance on a theory-of-mind task assessing the ability to infer other individuals' mental and emotional states from facial cues, while emotion regulation and quality of life were assessed using standardized self-report questionnaires.

Data Collection Tools

The World Health Organization Quality of Life–BREF questionnaire (WHOQOL-BREF) was used to assess participants' quality of life. The WHOQOL-BREF was developed by the World Health Organization as a shortened version of the original 100-item WHOQOL instrument to provide a practical and culturally applicable measure of perceived quality of life. The instrument consists of 26 items and assesses four principal domains of quality of life, including physical health, psychological health, social relationships, and environmental health, in addition to items addressing overall quality of life and general health perceptions. Responses to the questionnaire are transformed according to the recommended scoring procedure so that domain scores can be expressed on a standardized scale ranging from 0 to 100, with higher scores representing a more favorable perceived quality of life. The questionnaire has been translated into numerous languages and has been applied extensively across different cultural and clinical populations. Evidence from the original World Health Organization validation studies has supported its cross-cultural applicability and psychometric adequacy. The Persian version of the WHOQOL-BREF has also demonstrated satisfactory reliability and construct validity in Iranian populations. Previous Iranian psychometric evaluation reported

an overall Cronbach's alpha coefficient of approximately 0.84, indicating acceptable internal consistency. Factor analytic findings further supported the four-domain structure of physical health, psychological health, social relationships, and environmental health. Test–retest reliability coefficients reported for the Persian version were approximately 0.77 for physical health, 0.77 for psychological health, 0.75 for social relationships, and 0.84 for environmental health, providing additional evidence for the temporal stability of the instrument.

Social cognition was assessed using the Reading the Mind in the Eyes Test (RMET), developed by Baron-Cohen and colleagues and revised in 2001. The test is widely used as a measure of theory of mind and the capacity to infer another person's mental or emotional state from subtle visual information. The revised version consists of 36 items, each presenting a photograph showing only the eye region of a human face. The photographs represent different mental and affective states, such as calmness, discouragement, fear, suspicion, or other complex psychological states. For each photograph, participants are required to select from the presented alternatives the term that most accurately describes what the person in the photograph is thinking or feeling. Each correct response receives a score of 1, whereas an incorrect response receives a score of 0; unanswered items do not receive a score. Consequently, total scores range from 0 to 36, with higher scores reflecting a greater ability to infer mental states and thus a higher level of social-cognitive functioning. Scores below 22 have commonly been interpreted as reflecting relatively low mind-reading ability, scores from 22 to 31 as reflecting a moderate level, and scores above 31 as indicating relatively high performance. The Persian version of the instrument has shown acceptable psychometric characteristics. In an Iranian validation study, a Cronbach's alpha coefficient of approximately 0.72 was reported, while the two-week test–retest reliability coefficient in a subsample of 30 participants was approximately 0.61. Additional evidence regarding the validity and internal consistency of the Persian form has also supported its use for assessing theory-of-mind-related aspects of social cognition in Iranian populations.

Emotion regulation was measured using the Emotion Regulation Questionnaire (ERQ), developed by Gross and John in 2003 to assess individual differences in the habitual use of major emotion-regulation strategies. The ERQ contains 10 items distributed across two dimensions: cognitive reappraisal, assessed through six items, and expressive suppression, assessed through four items. Cognitive reappraisal refers to changing the interpretation of an emotion-eliciting situation in order to modify its emotional impact, whereas expressive suppression refers to inhibiting or controlling the behavioral expression of an already activated emotional response. Respondents rate each item on a seven-point Likert scale ranging from 1, indicating strong disagreement, to 7, indicating strong agreement. Subscale scores are calculated according to the relevant items, with higher scores indicating greater use of the corresponding emotion-regulation strategy. The original validation study reported satisfactory internal consistency coefficients of approximately 0.79 for cognitive reappraisal and 0.73 for expressive suppression. Subsequent research has similarly demonstrated adequate reliability, with coefficients of approximately 0.83 for reappraisal and 0.79 for suppression. Psychometric evaluation of the Persian version has also supported its applicability in Iranian samples, with Cronbach's alpha coefficients of approximately 0.83 for cognitive reappraisal and 0.79 for expressive suppression. In the present study, the ERQ was used to represent the emotion-regulation construct within the proposed structural model and to examine its mediating role in the association between social cognition and quality of life.

Data Analysis

Data analysis was conducted at both descriptive and inferential levels. Initially, the collected data were screened for completeness, coding errors, missing values, and potentially influential observations. Descriptive statistics, including frequency, percentage, mean, standard deviation, minimum, and maximum values, were calculated as appropriate to describe participants' characteristics and the distributions of the principal study variables. The distributions of continuous variables were examined for normality through indices of skewness and kurtosis, and the internal consistency of the questionnaire-based measures was evaluated using Cronbach's alpha coefficients. Pearson correlation coefficients were subsequently calculated to determine the magnitude and direction of the bivariate associations among social cognition, emotion regulation, and quality of life. The hypothesized conceptual model was then evaluated using structural equation modeling. In the structural model, social cognition was specified as the predictor variable, quality of life as the outcome variable, and emotion regulation as the mediating variable. Both direct and indirect pathways were estimated in order to determine whether social cognition was associated with quality of life directly and whether part of this association operated indirectly through emotion regulation. Model adequacy was evaluated using multiple goodness-of-fit indices, including the chi-square statistic relative to degrees of freedom (χ^2/df), the Comparative Fit Index (CFI), Tucker–Lewis Index (TLI), Root Mean Square Error of Approximation (RMSEA), and Standardized Root Mean Square Residual (SRMR). Values of χ^2/df below 3, CFI and TLI values above 0.90, and RMSEA and SRMR values below 0.08 were considered indicative of an acceptable overall model fit. Standardized path coefficients, standard errors, critical ratios or corresponding test statistics, and significance levels were examined for individual structural relationships. The statistical significance of the mediating effect of emotion regulation was assessed through bootstrap estimation of the indirect effect and its confidence interval; an indirect effect was considered statistically significant when the bootstrap confidence interval did not include zero. Statistical significance for the primary analyses was set at $p < 0.05$. Descriptive and preliminary analyses were performed using SPSS, while the structural equation model and mediation pathways were evaluated using AMOS.

Findings and Results

The final sample consisted of 300 patients with traumatic brain injury. Of these participants, 190 (63.0%) were men and 110 (37.0%) were women. Regarding age distribution, 31 participants (10.3%) were aged 18–20 years, 72 (24.0%) were aged 21–30 years, 88 (29.3%) were aged 31–40 years, and 109 (36.3%) were aged 41–50 years. Thus, the largest proportion of participants belonged to the 41–50-year age group, whereas the smallest proportion was observed among those aged 18–20 years.

Table 1. Descriptive Statistics for the Study Variables

Kurtosis	Skewness	SD	Mean	Variable
0.687	-0.517	3.945	24.37	Social cognition
1.526	-0.872	4.320	28.11	Cognitive reappraisal
0.517	-0.534	3.514	16.48	Expressive suppression
1.319	-0.808	7.142	44.59	Emotion regulation
0.524	-0.160	3.093	20.03	Physical health
1.176	-0.501	3.803	22.10	Psychological health
1.424	-0.548	3.987	21.60	Social relationships
1.000	-0.770	3.889	19.63	Environmental health
1.077	-0.491	12.531	83.36	Quality of life

As shown in Table 1, the mean score for social cognition was 24.37 (SD = 3.945). Regarding emotion regulation, the mean scores for cognitive reappraisal and expressive suppression were 28.11 (SD = 4.320) and 16.48 (SD = 3.514), respectively, while the overall emotion regulation score had a mean of 44.59 (SD = 7.142). For quality of life, the mean scores were 20.03 (SD = 3.093) for physical health, 22.10 (SD = 3.803) for psychological health, 21.60 (SD = 3.987) for social relationships, and 19.63 (SD = 3.889) for environmental health. The overall quality-of-life score was 83.36 (SD = 12.531). Moreover, the absolute values of skewness and kurtosis for all study variables were below 2.00, indicating no substantial deviation from univariate normality.

Before testing the structural model, the statistical assumptions required for structural equation modeling were examined. The Kolmogorov–Smirnov test indicated that the distributions of social cognition, emotion regulation, and quality of life did not significantly deviate from normality, with test statistics of 0.156, 0.125, and 0.044 and corresponding significance levels of 0.098, 0.164, and 0.581, respectively (all $p > 0.05$). Multivariate normality was also supported by the Mardia coefficient of 2.316, which was within the acceptable range. Multicollinearity was evaluated using tolerance and variance inflation factor indices. For social cognition, tolerance was 0.661 and VIF was 1.512, whereas for emotion regulation, tolerance was 0.572 and VIF was 1.748. Because tolerance values were greater than 0.10 and VIF values were substantially below 10, no evidence of problematic multicollinearity was detected. In addition, the observed correlations among the study variables were below 0.90, further supporting the absence of excessive collinearity. Examination of univariate and multivariate outliers did not indicate problematic observations that would materially distort model estimation. Accordingly, the assumptions required for subsequent correlational and structural equation analyses were considered adequately satisfied.

Table 2. Correlation Matrix Among Social Cognition, Emotion Regulation, and Quality of Life

3	2	1	Variable
		1	1. Social cognition
	1	0.560**	2. Emotion regulation
1	0.583**	0.550**	3. Quality of life

As presented in Table 2, social cognition was positively and significantly correlated with emotion regulation ($r = 0.560$, $p < 0.01$) and quality of life ($r = 0.550$, $p < 0.01$). Emotion regulation was also positively and significantly correlated with quality of life ($r = 0.583$, $p < 0.01$). Thus, higher levels of social cognition were associated with greater emotion regulation and better quality of life, while greater emotion regulation was likewise associated with higher quality of life among patients with traumatic brain injury. The magnitude of the correlations was moderate, indicating meaningful associations among the principal variables without suggesting excessive overlap between the constructs.

Table 3. Direct and Indirect Effects of Social Cognition on Quality of Life

p	t	Standardized Effect	Unstandardized Effect	Path	Effect
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< 0.01	4.213	0.279	0.123	Social cognition → Quality of life	Direct effect
< 0.01	—	0.110	0.049	Social cognition → Emotion regulation → Quality of life	Indirect effect
< 0.01	—	0.389	0.172	Social cognition → Quality of life	Total effect

Structural equation modeling was used to examine the direct effect of social cognition on quality of life and the indirect effect operating through emotion regulation. The overall structural model demonstrated an acceptable fit to the observed data, with $\chi^2/df = 3.042$, IFI = 0.922, CFI = 0.921, NFI = 0.908, GFI = 0.917, RMSEA = 0.071, and SRMR = 0.059. These values were within commonly accepted thresholds and supported the adequacy of the proposed mediation model. As shown in Table 3, social cognition had a statistically significant positive direct effect on quality of life ($B = 0.123$, $\beta = 0.279$, $t = 4.213$, $p < 0.01$), indicating that greater social cognition was directly associated with better quality of life. In addition, bootstrap analysis demonstrated a statistically significant positive indirect effect of social cognition on quality of life through emotion regulation ($B = 0.049$, $\beta = 0.110$, $p < 0.01$). The total effect of social cognition on quality of life was therefore $B = 0.172$ and $\beta = 0.389$. Because both the direct and indirect effects remained statistically significant, the findings supported a partial mediating role of emotion regulation in the relationship between social cognition and quality of life. In other words, social cognition was associated with quality of life both directly and indirectly through emotion regulation among patients with traumatic brain injury.

Discussion and Conclusion

The present study examined the relationship between social cognition and quality of life in patients with traumatic brain injury (TBI), with particular emphasis on the mediating role of emotion regulation. The findings showed that social cognition was positively and significantly associated with both emotion regulation and quality of life, and emotion regulation was also positively related to quality of life. Structural equation modeling further demonstrated that social cognition had a significant direct effect on quality of life and a significant indirect effect through emotion regulation. Because both the direct and indirect pathways remained statistically significant, emotion regulation functioned as a partial mediator in the relationship between social cognition and quality of life. These findings suggest that patients with better social-cognitive abilities tend to report better quality of life not only because of the direct advantages associated with more accurate interpretation of social information, but also because stronger social cognition may facilitate more adaptive regulation of emotional responses.

The significant positive relationship between social cognition and quality of life is consistent with the broader literature emphasizing the importance of social information processing in post-TBI adjustment. Social cognition includes capacities such as recognizing emotional cues, inferring the intentions and mental states of others, understanding interpersonal situations, and adjusting behavior according to social context. These abilities are highly relevant to maintaining satisfactory relationships, participating in family and community life, returning to work, and preserving a sense of social competence following injury. Milders reported that impairments in social cognition following TBI are meaningfully related to disturbances in social behavior, indicating that deficits in interpreting social information can translate into practical interpersonal difficulties (11). In this regard, the present finding that higher social cognition was associated

with better quality of life can be understood as reflecting the central role of social understanding in successful psychosocial reintegration.

The direct effect of social cognition on quality of life may also be explained by the interpersonal consequences of brain injury. Patients with TBI may experience subtle but functionally important difficulties in recognizing emotion, interpreting facial expressions, understanding irony or intention, and appreciating the perspectives of others. These difficulties can increase the likelihood of misunderstandings, conflict, social withdrawal, and reduced participation in meaningful relationships. Williams and Wood demonstrated that TBI can be associated with alexithymia and reduced emotional empathy, both of which may interfere with the ability to understand and respond appropriately to emotional experiences in self and others (12). Because the social and psychological domains constitute major components of quality of life, persistent deficits in social understanding may reduce perceived well-being even when physical recovery is relatively favorable. Therefore, the present finding supports the view that social cognition should be regarded as an important determinant of long-term adaptation after TBI rather than as a secondary neuropsychological outcome.

The observed association between social cognition and quality of life is also compatible with research emphasizing the persistent nature of quality-of-life impairment following TBI. Rauen and colleagues showed that reductions in quality of life may persist for up to a decade after injury, suggesting that the long-term burden of TBI cannot be adequately understood through acute neurological indicators alone (7). Similarly, research on brain-injury-specific quality of life has highlighted the importance of examining subjective outcomes relative to normative reference populations (8), while broader work on health-related quality of life after TBI has emphasized that functional consequences may extend across childhood, adolescence, and adulthood (9). Recent findings in pediatric acquired brain injury similarly indicate that quality-of-life limitations may persist across multiple domains and therefore require multidimensional assessment (10). Taken together, these studies support the present conclusion that variables affecting interpersonal and emotional functioning are likely to be important contributors to perceived quality of life after brain injury.

The present study also found a significant positive relationship between social cognition and emotion regulation. This result is theoretically plausible because adaptive regulation of emotion depends partly on the accurate interpretation of social and emotional information. In many everyday situations, individuals must first recognize what another person is feeling, determine the meaning of the social context, infer intentions, and evaluate whether the situation is threatening, supportive, ambiguous, or neutral. Only after these appraisals can an appropriate emotional response be selected and regulated. If social cues are misunderstood, the emotional response may be disproportionate or contextually inappropriate. Thus, better social cognition may provide more accurate input for emotion-regulation processes and thereby facilitate more adaptive emotional responses.

This interpretation is strongly supported by rehabilitation research that has treated social cognition and emotion regulation as interrelated clinical targets. Westerhof-Evers and colleagues developed the T-ScEmo intervention specifically to address social cognition and emotion regulation in patients with TBI, suggesting that these domains are functionally connected and can be trained within an integrated rehabilitation framework (13). The present findings are consistent with this perspective, as they indicate that individuals with stronger social-cognitive functioning also tend to exhibit more effective emotion regulation. The

relationship between these constructs may therefore reflect a broader system of social-emotional functioning in which accurate recognition and interpretation of interpersonal information support more adaptive management of emotional states.

The significant relationship between emotion regulation and quality of life also accords with previous evidence. Emotion regulation influences how individuals cope with distress, frustration, uncertainty, interpersonal difficulties, and changes in personal roles. Following TBI, patients frequently encounter situations that place considerable demands on emotional control, including reduced independence, changes in employment status, altered family dynamics, persistent symptoms, and uncertainty about long-term recovery. Individuals who are more capable of reappraising difficult situations, modulating emotional arousal, and avoiding maladaptive responses may be better able to preserve psychological well-being and social participation. In contrast, persistent dysregulation may contribute to irritability, anxiety, depressive symptoms, interpersonal conflict, and withdrawal.

The findings of Stubberud and colleagues provide important support for this interpretation. They found that emotional regulation following acquired brain injury is associated with executive functioning in daily life and with symptoms of anxiety and depression (16). This suggests that difficulties in regulating emotion are not isolated psychological complaints but are embedded within broader patterns of functional and emotional adjustment. The relevance of emotion regulation after acquired brain injury is further supported by the development of specialized measures designed to assess this construct in neurological populations (15). These lines of evidence are consistent with the present finding that emotion regulation is positively associated with quality of life and indicate that the capacity to regulate emotion may substantially influence how patients experience and adapt to the consequences of TBI.

The present results are also supported by broader evidence linking emotion regulation to social adaptation. Farsijani and colleagues demonstrated that emotion regulation contributes to the prediction of social adjustment, highlighting the importance of emotional self-management for effective interpersonal functioning (17). Although that study was not conducted specifically in a TBI population, the conceptual implication is relevant to the present findings. In patients with TBI, adaptive emotion regulation may help reduce the interpersonal consequences of frustration, impulsive responses, and emotional lability, thereby facilitating more satisfactory relationships and greater participation in everyday life. This mechanism may be especially important because social participation itself contributes substantially to perceived quality of life.

The most important finding of the present study was the significant mediating role of emotion regulation in the relationship between social cognition and quality of life. This result indicates that social cognition influences quality of life through at least two pathways. One pathway is direct, whereby better social understanding may improve interpersonal relationships, social participation, and adaptive functioning. The second pathway is indirect, whereby better social cognition facilitates more effective emotion regulation, which in turn contributes to improved quality of life. Because the mediation was partial rather than complete, emotion regulation explains part, but not all, of the relationship between social cognition and quality of life.

This mediating mechanism is conceptually consistent with the social-emotional regulation framework described in other psychological contexts. Kupferberg and Hasler emphasized that impaired social emotion

regulation, social cognition, and interpersonal behavior can interact to produce broader reductions in social functioning (18). Although their work focused on depression rather than TBI, the underlying mechanism is relevant: accurate social information processing and effective emotion regulation jointly support adaptive interpersonal behavior and social functioning. In individuals with TBI, disruption in one component may therefore contribute to difficulties in the others, while preserved or rehabilitated social cognition may promote better emotional adjustment and, ultimately, better quality of life.

The mediating role of emotion regulation can also be explained from a neurobehavioral perspective. TBI often affects neural systems involved in both executive-emotional control and social information processing. Consequently, patients may have difficulty not only understanding what is occurring in an interpersonal situation but also modulating the emotions elicited by that situation. If a patient incorrectly interprets another person's facial expression or intention, the resulting emotional reaction may be excessive, inappropriate, or difficult to control. Repeated experiences of this kind may contribute to strained relationships, reduced confidence in social interaction, and lower perceived quality of life. Conversely, when social-cognitive processing is more accurate, patients may have a more reliable basis for reappraising social situations and selecting contextually appropriate emotional responses.

The significance of emotion regulation is further underscored by the high prevalence and clinical importance of emotional symptoms following TBI. Depression represents a common post-injury complication, and recent meta-analytic evidence has examined the effectiveness of non-invasive brain stimulation for depressive symptoms in TBI populations (19). The relevance of depression to the present findings lies in the fact that emotional dysregulation may contribute to, or coexist with, affective symptoms that reduce quality of life. Therefore, interventions directed at emotion regulation may have broader benefits that extend beyond immediate emotional control to psychological health, social participation, and subjective well-being.

The present findings are also consistent with the broader evolution of TBI care toward integrated and long-term management. Maas and colleagues emphasized that TBI should be approached through integrated models encompassing prevention, acute care, rehabilitation, and long-term research rather than as a single acute medical event (3). Similarly, recent initiatives have sought to standardize TBI care across hospital systems and trauma services to improve consistency and outcomes (4, 5). Although such approaches often begin with acute clinical management, the present findings suggest that long-term care should also incorporate systematic assessment of social cognition and emotion regulation. Patients may survive the injury and regain physical independence while continuing to experience deficits in social understanding and emotional self-management that substantially reduce their quality of life.

This interpretation is particularly important given the global burden of TBI. Dewan and colleagues demonstrated the substantial worldwide incidence of TBI and emphasized its considerable public health impact (1), while Majdan and colleagues documented important epidemiological patterns across European populations (2). In addition to the direct burden of injury, patients may experience secondary neurological complications such as post-traumatic epilepsy, which can further influence functioning and well-being (6). These broader burdens make it increasingly important to identify modifiable psychological mechanisms associated with quality of life. Social cognition and emotion regulation are especially relevant in this regard because they can be assessed clinically and may be responsive to rehabilitation.

The potential modifiability of these processes is supported by emerging rehabilitation approaches. The T-ScEmo intervention directly targets social cognition and emotion regulation following TBI (13), while newer digital and mobile rehabilitation approaches are increasingly being developed to improve cognitive processes in ecologically valid contexts (14). Such developments suggest that neuropsychological rehabilitation is moving toward more individualized, functionally oriented, and technology-supported interventions. The current findings support extending these efforts toward combined social-cognitive and emotional interventions because improvements in these areas may translate into better real-world functioning and quality of life.

The findings concerning social cognition can also be interpreted in light of research on emotional-face processing. Reidy and colleagues showed that neural responses to emotional faces are sensitive to individual psychological and physiological conditions (20). This is relevant because the Reading the Mind in the Eyes Test used in the present study depends on the ability to extract emotional and mental-state information from subtle facial cues. In patients with TBI, greater accuracy in processing such cues may facilitate more appropriate social responses and more adaptive emotional reactions. Therefore, the observed relationship between social cognition, emotion regulation, and quality of life may reflect a broader capacity to process and respond effectively to socially meaningful emotional information.

Overall, the findings of the present study extend previous research by integrating three clinically important constructs within a single explanatory model. Previous studies have independently demonstrated that TBI can impair social cognition, emotion regulation, psychological functioning, and quality of life, but the present results suggest that these domains are structurally interconnected. Social cognition was directly associated with quality of life, and part of this relationship was explained by emotion regulation. This finding has theoretical significance because it supports a pathway in which social understanding influences subjective well-being partly through the capacity to regulate emotional responses. It also has clinical significance because emotion regulation represents a potentially modifiable mechanism that may be targeted when social-cognitive difficulties contribute to poor adjustment after TBI.

The present study had several limitations that should be considered when interpreting the findings. First, the correlational and cross-sectional design does not permit causal conclusions regarding the direction of relationships among social cognition, emotion regulation, and quality of life. Although the proposed mediation model was theoretically grounded, alternative causal pathways remain possible. Second, participants were selected through convenience sampling from a single hospital in Tehran, which may limit the generalizability of the findings to patients in other clinical settings, geographical regions, cultural contexts, or levels of injury severity. Third, emotion regulation and quality of life were assessed primarily through self-report measures, which may be influenced by response bias, current mood, insight, or social desirability. Fourth, potentially relevant clinical characteristics such as injury severity, time since injury, lesion location, medication use, rehabilitation history, and comorbid psychiatric symptoms were not incorporated into the structural model. Finally, although the Reading the Mind in the Eyes Test provides an established measure of theory-of-mind-related social cognition, social cognition is a broader construct that also includes emotion recognition, attributional processes, empathy, and social decision-making.

Future studies should employ longitudinal designs to examine how social cognition, emotion regulation, and quality of life change across different stages of recovery after traumatic brain injury and to provide

stronger evidence regarding temporal and causal pathways. Recruiting larger and more diverse samples from multiple hospitals and rehabilitation centers would improve generalizability and permit subgroup analyses based on injury severity, age, sex, time since injury, and rehabilitation status. Future research could also incorporate additional measures of social cognition, including facial emotion recognition, empathy, perspective taking, and social problem solving, in order to provide a more comprehensive assessment of this construct. It would also be useful to include clinical variables such as depressive symptoms, anxiety, fatigue, sleep quality, neurological complications, and functional independence as potential moderators or additional mediators. Experimental and intervention studies should further determine whether improving social cognition or emotion regulation produces measurable improvements in quality of life and whether combined interventions are more effective than approaches targeting either domain independently.

In clinical practice, assessment of patients with traumatic brain injury should extend beyond physical and general cognitive functioning to include systematic evaluation of social cognition, emotion regulation, and quality of life. Rehabilitation teams may benefit from identifying patients who have difficulty interpreting social cues or managing emotional responses, even when these problems are not immediately apparent during routine neurological examinations. Neuropsychological and psychological rehabilitation programs should incorporate training in emotion recognition, perspective taking, cognitive reappraisal, emotional awareness, and adaptive regulation strategies. Family members and caregivers may also benefit from education about the social-emotional consequences of TBI so that interpersonal difficulties are not interpreted solely as intentional or personality-based behavior. Integrating social-cognitive and emotion-regulation interventions into multidisciplinary rehabilitation may help improve interpersonal functioning, community participation, psychological adjustment, and ultimately the overall quality of life of patients with traumatic brain injury.

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Authors' Contributions

All authors equally contributed to this study.

Declaration of Interest

The authors of this article declared no conflict of interest.

Ethical Considerations

The study protocol adhered to the principles outlined in the Helsinki Declaration, which provides guidelines for ethical research involving human participants.

Transparency of Data

In accordance with the principles of transparency and open research, we declare that all data and materials used in this study are available upon request.

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