Predicting the Quality of Life of Patients with Mild Traumatic Brain Injury: A Study Based on Psychological Variables

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Abstract

Background: Recognizing the factors related to psychological disorders such as depression, stress, anxiety, and other related problems in a mild traumatic brain injury (MTBI) can be helpful in designing more effective treatment protocols. This study aimed at examining the effect of some prevalent psychological issues on predicting the quality of life of the MTBI patients. **Methods:** In this descriptive correlational study, 322 MTBI patients (mean age, 38.8 ± 10.8 years) who had admitted to the emergency and neurosurgery departments of Kashan Shahid Beheshti Hospital during April–July 2017 were selected using the convenient sampling method. Data were collected using the quality of life (WHOQOL-BREF) questionnaire (as a dependent variable), mental fatigue questionnaire, and depression, anxiety and stress scale (DASS-21). Finally, the data were analyzed in SPSS-23 by multiple regression analysis. **Results:** The results of the study showed that the regression model was significant ($P < 0.001$), in which 43% of total changes in the quality of life in MTBI patients were predicted by mental fatigue, depression, stress, anxiety, and gender. **Conclusion:** The findings of this study show that there is a negative relationship between psychological factors and quality of life among the MBTI patients. Thus, it is suggested to design more specific psychological-based rehabilitation programs with regard to gender differences to improve the quality of life among these patients after discharging from the hospital.

Keywords: Anxiety, depression, mental fatigue, mild traumatic brain injury, quality of life, stress

INTRODUCTION

Traumatic brain injury (TBI) also known as "silent epidemic" is one of the prevelent brain-related diseases. Despite the increasing attention paid by media to military- and sports-related TBI, this is no longer the case. However, as a result of this increased attention, a new silent epidemic has become under the spotlight: TBI among older adults. Although the number of motor cycle accidents related to TBI has been successfully reduced, fall-related TBI has been increased among older adults who have rising numbers of Emergency Department visits, hospitalizations, and death.[1]

TBI among older adults is mainly associated with falls, and women are affected more than men. In contrast, TBI in younger adults is mainly associated with motor cycle accidents, with men being affected more than women.[2,3] This catastrophic

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experience transforms every human's life after injury, causing acute or prolonged injuries, which greatly affects the quality of life of the individuals.[4,5] TBI is a brain injury that results from an external mechanical force on the head and can be associated with serious disabilities in physical, cognitive, psychological, and social functions of the person.[6] According to the World Health Organization, TBI will surpass many diseases by 2020; it is also one of the leading causes of mortality and long-term disability for people aged 35 years and younger.[7-9] Studies have shown that approximately 80,000–90,000 people live in long-term disability following TBI. Among TBI patients, 5% will die; 14% of the cases may have moderate to sever symptoms, and the rest, that is, a significant percentage, fall into the category of mild trauma.[8,10] Over recent years, significant improvements in head trauma surgery and improvement of hospital services and the care system have led to an increase in the survival and recovery of patients with TBI in Iran. However, significant cognitive, psychological, and motor impairments will remain for many patients.[11] Although there is no precise statistic of TBI's epidemiology in Iran, it is revealed that, unfortunately, this country is among the top countries of the world in terms of daily accidents.[9,12] In a study conducted in Kashan city, of every 100,000 people, 429 people have experienced traumatic brain damage, which is higher than many other countries of the world.[13] TBI can lead to various damages that play an important role in long-term disability, economic dependence, and family problems, which are among these limiting conditions.[6] Patients with TBI have trouble in returning to the previous level of performance and active participation in the community after physical and medical treatments.[14] In addition, the occurrence of psychiatric disorders after TBI can lead to a wide range of biopsychosocial problems and be the risk factor for mental disorders.[6] Understanding the epidemiology and the nature of the psychiatric disorder syndrome after TBI not only can help to understand the outcome of brain-related disorders but also may enrich neuropsychiatric rehabilitation techniques in patients and modify the existing therapies. One of the important things that can be influenced by TBI is the quality of life of TBI patients.[15] In recent years, the concept of quality of life has been considered as an important indicator of assessing individual health, decision-making, and judgment about the overall well-being in societies. Moreover, finding the major problems in various aspects of the lives of individuals, especially patients with one of the different chronic diseases, seems necessary.[16] Mental fatigue is another common clinical observation in the TBI patients, which includes psychophysical exhaustion. Many people who have experienced TBI are constantly challenged with persistent signs of the mental fatigue that affects their functions, including occupational, personal, and social activities.[17-19]

Significant evidence suggests that stress results in lasting neurobehavioral abnormalities in TBI patients, which, in turn, can be associated with impairments in recovery process and, in some more severe cases, leads to post-traumatic stress disorder.[20,21] Post-TBI depression is an another consequence of TBI, which has a high prevalence of 60%–70%. Depression reduces the patient's motivation to continue the treatment, causes the incidence of dementia, and has a negative effect on the disease prognosis.[22,23] Anxiety can also appear as a prevailing psychological disorder following TBI and reduce the recovery rate consequently.[24-26] In general, previous studies have confirmed the existence of psychological disorders as one of the definite outcomes of brain injury.[27-30]

While there are several studies devoted to the relief of medical symptoms after mild traumatic brain injury (MTBI), limited information is available on the neuropsychological rehabilitations. As reported previously, unsolved mental health issues may lead to increased years of recovery and high economic costs for individuals and health systems. According to the results of the previous related studies, it is necessary to take into account mental health factors in treatment procedures in order to improve TBI patients' psychological disorders (including depression, anxiety, and stress), caused by interacting with their illness consequences. This study aimed at investigating the role of mental fatigue, stress, depression, and anxiety along with demographic information in predicting the quality of life of patients with MTBI. We hypothesized that by a quick evaluation after injury, psychological disorders can be distinguished and treated.

METHODS

This descriptive correlational study was conducted on all MTBI patients admitted to the emergency and neurosurgery departments of Kashan Shahid Beheshti Hospital in 2017. Then, 322 MTBI patients were selected using the convenience sampling method.

Patients were given a written description of the trial and were offered participation in the study if they met the following criteria: (1) 18–50 years old; (2) a Glasgow Coma Scale (GCS) score of 13-15; (3) a post-traumatic amnesia more than 1 h; (4) localized or disseminated brain tissue damage caused by an external mechanical force; (5) brain imaging findings such as skull fracture or acute brain injury; (6) no history of previous neurological/psychiatric diseases or substance abuse; and (7) informed consent to participate in the study. The exclusion criteria of the study were the presence of any neurological disease before TBI, non-TBI such as brain tumor or stroke, and patients who were dissatisfied with entering the research for any reason.

At this stage, 322 patients were identified by diagnosis of a physician (neurosurgeon) and their hospital records were reviewed and initially evaluated within a maximum of 10 days after they arrived at the hospital. After obtaining the patients' consent forms, their demographic information was collected, and then, questionnaires were used to measure the desired variables.

Tools

1. A demographic and hospital information checklist

including age, gender, education level, and marital status of the MTBI patients

2. The World Health Organization Quality of Life-BREF (short version) (WHOQOL-BREF) was developed for measuring quality of life by World Health Organization: In Iran, it has been translated and standardized according to scientific principles, and its reliability and validity have been approved to be used in persian population. Internal consistency was measured using Cronbach's alpha of the four aspects, which was 0.77 in the patient group and 0.73 in the healthy group[31,32]

   The questionnaire consists of 26 items. The first and second items have been developed to assess overall quality of life and general health facet. The next 24 items assess the quality of life in four items of physical health, psychological items, social relationship items, and the living environment items. Items are rated on a five-point Likert scale. Participants scores range between 4 and 20.[33]

3. The mental fatigue questionnaire is a multidimensional self-report questionnaire with 15 items. It is consists of cognitive, psychological, sensitive symptom, and sleep quality subscales. This questionnaire was prepared by Johansson and Ronnback in 2009–2010 to examine the dimensions of mental fatigue in patients with neurological disorders, and its Cronbach's alpha coefficient was reported to be 0.9. The score range is from 0 to 42, and higher scores reflected a more severe symptom.[34,35] The questions included were about fatigue in general, lack of initiative, mental fatigue, mental recovery, concentration difficulties, memory problems, slowness of thinking, sensitivity to stress, increased tendency to become emotional, irritability, sensitivity to light and noise, decreased or increased sleep, and 24-h variations. The current study is the first to investigate the psychometric characteristics of the mental fatigue scale (MFS). First of all, it was translated into Persian, and then, two English professional translators used a back-translation method in order to find an equivalent and acceptable form. Differences between the two back-translated forms were evaluated for achieving a desired result through an iterative review process. Then, 20 student were asked to complete the MFS for checking possible problems in implementation. Finally, after some modifications, the validity and reliability of the Persian form of the scale were assessed. In the current study, the MFS showed high internal consistency ($\alpha = 0.91$)

4. The short form of depression, anxiety, and stress scale-21 (DASS-21) includes 3 subscales (depression, anxiety, and stress) and 21 items. The depression subscale included expressions of unhappy mood, lack of self-esteem, despair, worthlessness of life, loss of interest in dealing with affairs, lack of pleasure in life, and lack of energy. In Persian population, it has been validated by Asghari *et al.*[36] Each of the DASS-21 subscales consists of 7 questions; the final score of each subscale was obtained through the total score of related questions. Each question was scored from 0 (it does not apply to me at all) to 3 (totally applies to me). The test–retest reliability coefficient for the stress subscale was 0.80; for depression, it was 0.81; it was 0.78 for anxiety; and it was 0.82 for total scale. In addition, alpha coefficients for these factors were 0.97, 0.92 and 0.95, respectively.[36,37]

Procedure

The researchers used an anonymous paper survey for collecting data during the period of April–July 2017. After screening based on medical and psychiatric disorders, an appointment were made for each patient in Shahid Beheshti Hospital, Kashan, Isfahan, Iran. They individually answered the test booklet under the supervision of the first author. Written informed consent was obtained from all participants, and the Research Ethics and Governance Committee at Kashan University of Medical Sciences approved the study protocol.

Data analysis

Pearson's correlation and multiple linear regression models were utilized to examine the relationship between psychological status and quality of life of the patients using SPSS version 23 statistical package for social sciences. The Kolmogorov–Smirnov test was used for normality of data. Homoscedasticity was checked using the scatter plot. Multiple outliers were assessed by Mahalanobis distance. Furthermore, an independent *t*-test was applied to compare the groups means.

RESULTS

Basic characteristics of study population

The mean age of the patients was 38.8 ± 10.8 years, of which more than a half were males (55.9%) and married (68.4%) [Table 1]. All of the patients lived in Kashan, Iran, and were Farsi-native speakers. The mean and standard deviation of the measured variables in the whole studied sample are reported in Table 2 by gender. Results from an independent *t*-test showed that the mean scores of anxiety, stress, and quality of life were significantly higher in males than in females ($P < 0.01$). No

Table 1: Demographic information of participants

Variables	Status	Free count (%)
Gender	Male	180 (55.9)
	Female	142 (44)
Marital status	Single	102 (31.6)
	Married	220 (68.4)
Education	Under diploma	56 (17.3)
	Diploma	106 (32.9)
	B.A	143 (44.4)
	M.A	14 (4.3)
	Ph.D	3 (0.9)
Age	<20	46 (14.2)
	20-30	186 (57.7)
	30-40	74 (22.9)
	40-50	16 (4.9)

B.A: Bachelor of art, M.A: Master of art, Ph.D: Doctor of philosophy

significant difference was observed between the mean scores of depression and mental fatigue in two groups of males and females. In the following sections, correlational matrix is presented first. Then, regression analysis assumptions and results of the multiple regression analysis for psychological symptoms (depression, anxiety, stress, and mental fatigue) are reported in detail.

Correlational matrix among variables

The univariate correlations (Pearson's correlation) between mental fatigue, depression, stress, anxiety, and the quality of life are presented in Table 3. As reported in Table 3, there was a significant negative relationship ($P < 0.001$) between mental fatigue, depression, stress, anxiety, and quality of life; i.e., by decreasing the levels of psychological symptoms (depression, anxiety, stress, and mental fatigue), quality of life was improved subsequently. Anxiety has the strongest negative correlation ($r = -0.57$) with quality of life among TBI patients. To examine the impact of mental fatigue, depression, stress, and anxiety on the quality of life, multiple regression analysis was used.

Homoscedasticity and normality of error distribution were checked before running the regression. The normality of distribution of the scores was determined by the Kolmogorov–Smirnov test. The results revealed that the variables had normal distribution. Homoscedasticity was checked using the scatter plot. In the present data, the residuals and the variance of the residuals were the same for all predicted variables. Multiple outliers were assessed by Mahalanobis distance. None of the distances were bigger than or equal to Chi-square, so there were no multiple outliers among the data.

Regression analysis

A step-by-step multiple regression analysis was carried out to predict the quality of life (criterion variable) based on depression, anxiety, stress, and mental fatigue (predictive variables). Three models were implemented in which the third one demonstrated the highest R square. This model was included three variables (anxiety, depression, and mental fatigue). Further, we added demographic information including age, gender, and education to the regression analysis. The results are presented in Table 4. According to Table 4, a significant regression equation was found: (F (7, 314) = 33.58, $P < 0.001$) with an $R^2 = 0.43$, which confirmed that the model adequately fits the data. Overall, the results showed that three out of four variables were significant in predicting quality of life (stress was removed from the model). Among demographic information, only gender was significant ($P < 0.003$). Approximately 43% of the variance was explained by the current model. This model takes the form of a statistical equation where:

Ypred = $a + b1\ x1 + b2\ x2 + b3\ x3 + b4\ x4$.

Ypred = 113.9 − 0.94 (anxiety) − 0.59 (depression) − 0.49 (mental fatigue) − 4.09 (gender).

Can be observed, anxiety has the most predictive power.

Table 2: Descriptive statics of research variables

Variable	Mean±SD			P
	Total	Women	Men	
Depression	12.50±5.11	12.39±4.99	12.85±5.50	0.505
Anxiety	12.95±4.56	12.29±4.47	15.16±4.19	<0.001
Stress	14.29±4.64	13.90±4.55	15.59±4.75	0.006
Mental fatigue	24.18±4.77	24.25±5.22	23.95±2.86	0.521
QOL	75.48±12.41	46.16±10.81	50.12±8.67	0.001

SD: Standard deviation, QOL: Quality of life

Table 3: Correlation matrix among variables

Variables	QOL	Depression	Anxiety	Stress	Mental fatigue
QOL	1				
Depression	−0.5**	1			
Anxiety	−0.57**	0.54**	1		
Stress	−0.51**	0.53**	0.81**	1	
Mental fatigue	−0.45**	0.41**	0.49**	0.43**	1

**Significant at level $P<0.01$, the relationship between the variables is the indicator of a significant relationship at the error level of <0.01 and a confidence level of 0.99. QOL: Quality of life

Table 4: Regression analysis of psychological symptoms

Variable	B	SEB	β	t	P
Anxiety	−0.94	0.15	−0.34	−6.3	0.001
Depression	−0.59	0.13	−0.24	−4.6	0.001
Mental fatigue	−0.49	0.13	−0.19	−3.6	0.001
Gender	−0.044	10.35	−0.14	−3.02	0.003

SEB: Standard error for the unstandardized beta

DISCUSSION

This study aimed at examining the effect of mental fatigue, depression, stress, and anxiety on predicting the changes in quality of life of MTBI patients. Correlation analyses showed that quality of life has a significant relationship with all predictive variables. The results obtained from the regression analyses also indicated that anxiety has been able to predict the quality of life. In other words, psychological issues predict more than a half of variance of the quality of life variable in MTBI patients. According to the results, it can be said that the variables of anxiety have a significant effect on the quality of life.

The findings of this study are consistent with the results of many studies including the following research in terms of the existence of mental disorders as one of the common post-TBI consequences.[27-29] However, in some studies, the incidence of mental disorders was not observed in MTBI patients until 1 year.[38-41] In general, addressing the issue of incidence of post-TBI mental disorders is not an emerging phenomenon, and even they have been referred in the classic researches of the 1st year of the twentieth century. For example, Emil Kraepelin believed that local brain damage could be a direct cause of depression disorder and damage to parts of the

brain was associated with various psychosocial complaints.[27,30,33,42-44] generally, it can be said that the frequency rates of mental disorders in the post-TBI phase along with many new cases of personality change are high; the anxiety mood disorders are dramatically high, and TBI patients should be monitored and evaluated at least at the 4-month follow-up after TBI for the emergence of mental disorders for preventive measures and better pathologic management.[28] According to research,[45] after GCS clearance, the psychological variables in TBI patients are the powerful factors predicting psychological and motor effects, which is consistent with the hypotheses of the present study. Given that the TBI patients participated in our research were evaluated just 10 days after the impact, it can be concluded that the incidence and severity of mental disorders are reliable predictive factors of their quality of life after TBI. In addition, the results showed that improvement of the psychological and cognitive status of patients increases the degree of independence in their motor and psychological functions, and this reduces their overload years at their young age.[28] As Hibbard *et al.,* Fann *et al.*, and Koponen *et al.*[6,29,30] have shown, a significant number of patients show some signs of mental abnormality, years or even decades after TBI. Given the findings of this study on the ability to evaluate and track the psychological and cognitive consequences even a few days after the impact, it seems necessary to take preventive care to screen patients with TBI exposed to the risk of developing psychological and cognitive impairment.[46]

With regard to our finding from the regression model on the effects of variable of anxiety on the quality of life, it may be due to fact that a high level of anxiety in the MTBI patients can directly affect the quality of life, and in the absence of therapeutic interventions, it imposes widespread harms to people's lives. This is consistent with the result of the study conducted by Babikian *et al.*[40]

Conclusion

The results of the current study confirmed the relationship between the level of anxiety in MTBI patients and their quality of life after being discharged from the hospital. Accordingly, it has been determined that one of the important complications of TBI is the emergence of psychological and cognitive disorders. Additionaly,with regard to the mean age of TBI patients at the time of incident, which is mostly in a sensitive period of young adulthood and the increasing incidence rate of TBI day to day, applying appropriate psychological intervention can help the patients return to ordinary normal life. One of the effective methods to achieve this goal is a program of rehabilitation. The goal of rehabilitation is to help the patient achieve and maintain maximum independence in doing their daily activities thus, the rehabilitation program serves as an important therapeutic goal for both patients and society due to decrease in the disease burden.

Therefore, it is necessary to reinforce the sense of independence with emphasizing on remaining abilities and help them to take care of themselves and their mental health. According to our study, gender differences may affect the way patients suffer or/ and recover from TBI, and paying attention to such differences is necessary for designing more efficacious protocol.

This study has made it possible to access and analyze the factors affecting the quality of life of TBI patients, which can affect designing new rehabilitation programs. In addition, it is suggested that (1) in future researches, the psychological rehabilitation program should be implemented after the injury, (2) a psychologist should be present as a member of specialist treatment team in order to help the patients continue to live with the least difficulties. Furthermore, applying more precise statistical analysis like structural equation modeling can be more inspirational.

Conflicts of interest

There are no conflicts of interest.

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