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Implementation of Educational-Interactive-Psychiatric Management Software for Patients with Bipolar Disorder

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Abstract

Background: Bipolar disorder is considered a psychiatric disease without any effective screening questionnaire to monitor and manage Iranian patients. This study aims to implement a researcher-made questionnaire in the form of educational interactive software for better management of patients with bipolar disorder and prevent further complications.

Methods: The present cross-sectional study evaluated the efficacy of psychoeducational-interactive-therapeutic software for patients with bipolar disorder, which is a network-based software providing a researcher-made questionnaire in a planned manner. This software can predict the occurrence of future bipolar episodes for each patient by using artificial intelligence algorithms after the occurrence of two mood episodes as the training phase. The patients with bipolar disorder were asked to use the software for a year and their mood episodes were compared before and after using the software. We evaluate the reliability of the questionnaires in the software with internal consistency using alpha Cronbach test and test-retest analysis. Face validity and content validity were also evaluated .

Results: The content validity index of the instrument was 93%, and the Cronbach's alpha coefficient of the whole questionnaire was 0.955. Also, the ICC coefficient for this questionnaire is above 0.70, and the correlation coefficient of the answers in all constructs of the questionnaire is more than 0.8. Thirty male patients with bipolar disorder who experienced four episodes of mood swings per year experienced an average of 2 mood episodes per year following the use of this software.

Conclusion: Our Psychoeducational-interactive-therapeutic software is the first Persian language software based on artificial intelligence to monitor clinical symptoms in patients with bipolar disorder, which uses a standard questionnaire to predict the incidence of episodes of depression and mania in these patients.

Keywords: Bipolar disorder, Interactive software, Educational software, Artificial intelligence

Conflicts of Interest: None declared
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Introduction

In recent years, information and communication technology has helped improve the quality of health care services through better and more effective communication between physicians and patients (1). In the meantime, smartphones provide many opportuniti es to monitor and treat diseases, which is referred to as mobile health (1, 2). Mobile health is used in many cases of chronic diseases, including educating patients and caregivers, providing better management, and increasing adherence to treatment (3-5). Patient education on prevention and post-treatment care is one of the essential applications of mobile phones (5, 6). Patient education is essential in patients with chronic diseases in which the person is dealing with long-term therapies (7). Psychiatric diseases, including mood disorders, are among

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↑What is "already known" in this topic:
Bipolar disorder is considered a psychiatric disease, and it can be diagnosed by a questionnaire.

→What this article adds:
Psychoeducational-interactive-therapeutic software is being developed, and there is no need for handy questionnaires. The data can be collected easily without any human error.

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the chronic diseases that can benefit from mobile health. Bipolar disorder, as the most common subtype of mood disorder, has various adverse effects on social life and daily activities, and despite the provision of drug treatments, patients are dealing with significant recurrence (8). Mixed courses include simultaneous mixtures of depression and mania or hypomania (9). The disease most often begins with depression and is recurrent. Most patients experience manic and depressive episodes, while only 10 to 20% of patients experience only mania episodes. As the disease progresses, the time interval between periods often decreases, and five to fifteen percent of people with bipolar disorder develop at least four relapses in a year, known as rapid-cycling (10).

Unfortunately, many patients with bipolar disorder experience recurrent episodes throughout their lives if they do not receive proper treatment and follow-up. Recurrence periods may lead to adverse effects on the mental state of patients and their families. Moreover, direct and indirect costs of managing the acute phase of the disease are much higher than long-term and timely treatment of the disease (11). Therefore, early diagnosis and treatment of relapses are of great importance. Recent technological advances, including the availability of computer and mobile applications, led to better control and monitoring of the treatment of various diseases (12-14). However, psychiatric disorders, including bipolar disorder, are among the diseases without effective software for monitoring and management of the disease in our country, Iran. Therefore, in the present study, we aimed to validate our researcher-made screening questionnaire for bipolar disease relying on symptoms indicating disease recurrence, including discontinuation for dose reduction of mood-stabilizing drugs, insomnia, irregular sleep, lack of knowledge, and awareness about the disease in an educational-interactive software (15).

Methods

The present study took place in Ibn Sina Hospital, Mashhad, Iran. All participants consciously and voluntarily participated in the study. Informed consent was obtained after assuring patients about the confidentiality of the information.

The researcher made a WEB-based program

Bipolar Tracking Assistant (BTA) is a WEB-based software accessible by mobile phones. The software shares predefined information, which has been approved by the user, with the physician by continuously communicating with the central server of the program. The users were chosen from adult patients (older than 18 years) who were referred to the Ibn Sina Hospital outpatient clinic. After taking verbal informed consent, a psychiatrist activated the software for patients who had a confirmed diagnosis of any type of bipolar disorder based on the Diagnostic and Statistical Manual of Mental Disorders-V (DSM-V). None of the patients had any other medical illness or received any other medication except the psychiatric drug regimens prescribed by the psychologist for the bipolar disorder. Patient information, including phone number, age, gender, type of residence, medications, and phone number of a relative who usually lives with the patient, was recorded in a personal profile after taking an informed consent form once logging in to the program for the first time. After entering the program, the patient receives multiple-choice questions. The questions evaluate changes in sleep, appetite, mood, sexual desire, energy level, concentration, decision-making, medication use, and unconventional experiences. The patient is then redirected to another page of the software, documenting the amount of medication taken by the patient. On the next step, patients are taken to a page where daily tips on managing bipolar mental health are provided. The patient is asked to answer the researcher-made questionnaire on the last page. The software records all the information provided in these three steps, and the psychiatrist can view the results anytime. The patients were followed for two years, and those who did not keep using the software for two years or developed any other medical or psychiatric illnesses during the two years of the study were excluded.

The researcher-made questionnaire

The Young Mania rating scale and the Beck Depression inventory's questions about the main dimensions of mania, including mood, sleep, and energy, were considered the backbone questions of our researcher-made questionnaire. An attempt was made to select the best contents or sentences questioning the characteristics of the concept of evaluating different dimensions of bipolar symptoms. Then, the items were re-examined by members of the research team, including experienced psychiatrists and psychologists, and while making the necessary changes, the overlapping items were removed or merged according to their opinions. Finally, 17 items were provided to the target group to evaluate the content validity. The target group included patients referred to Ibn Sina Psychiatric Hospital in Mashhad, diagnosed with a mood disorder according to a structured psychiatric interview based on DSM-V criteria. A total of 70 randomly selected patients were included in the study (50% of patients were male), and a test-retest was taken after a one-week washout period. Content validity and construct validity were used to determine the psychometric properties.

Assessment of validity

When designing the questionnaire items, an attempt was made to use easy, simple, and logical writing. The sentences were studied and revised several times by the research team members. To evaluate the validity of the questionnaire, both quantitative and qualitative methods were used. Moreover, ten participants were interviewed about the difficulty of understanding, simplicity, clarity of the items, and the possibility of misunderstandings or inadequacies in the meanings of the words. Also, after the preliminary implementation of the questionnaire on 70 eligible individuals, every individual was questioned about these factors.

The content validity was assessed by obtaining experts' opinions about the comprehensiveness of the questions or any of the dimensions or the underlying concepts for each question. Therefore, the initial questionnaire was provided to 10 experts (a panel of experts including the Mashhad

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University of Medical Sciences psychiatry and psychology professors), and their opinions were used to improve the questionnaire's content. The experts were also asked to comment on the comprehensiveness of the questionnaire and the scales. Quantitative strategies for the assessment of content validity, including the calculation of the Content Validity Ratio (CVR) and Content Validity Index (CVI), were performed based on the comments by Waltz and Basel (16, 17). Experts were asked to rate each item of the questionnaire as one of the options, including necessary, useful, not necessary, and not necessary to calculate the CVR. CVR was interpreted based on the table proposed by Lavoshe et al. (18).

According to Polite et al.'s study (2016), items with a CVI above 0.78 are considered appropriate, and items with a CVI below this value need to be reviewed (19). The mean scores of the CVI of all remaining items were calculated as tool content validity index (S-CVI\Ave), which should be more than 0.9. Ten specialists rated the questionnaire items; therefore, the minimum acceptable CVR was 0.62.

Assessment of reliability

In the present study, reliability was investigated by internal consistency and test-retest methods (20). The most common method for calculating internal consistency is to calculate Cronbach's alpha coefficient. In the present study, Cronbach's alpha coefficient was calculated for each of the tool dimensions and the complete tool. According to Waltz et al. study, a one-week interval between two tests is appropriate for performing the test-retest method; therefore, the present study used a one-week wash-out period (16). A sample of 70 participants was used to determine the consistency of the questionnaire. The intra-class correlation coefficient (ICC) was calculated for all dimensions and tools as well as the whole tool. The ICC of the Two-way random model was used in the present study.

Evaluation of software efficiency

The Convolutional Neural Network (CNN/ConvNet) was used to predict the time of patient attacks in the BTA software system. In this model, the algorithm receives the input from the user and assigns the importance (learnable weights and bias) to each series of data and thus finally, the initial attack pattern was made and categorized by the models, and the software was then able to make a prediction. To evaluate the performance of the software, 30 male patients with bipolar disorder who experienced four recurrences last year were studied. The validity and reliability stages of the questionnaire used in the application were performed as described in detail in the previous section, and SPSS software version 16 was used to analyze the collected data.

Results

The CVR of the questionnaire is given in Table 1. The S-CVI\Ave was 93%, and the CVI was 0.8. Table 2 shows the reliability of the questionnaire constructs by Cronbach's method and intra-category correlation. Cronbach's alpha coefficient of the whole questionnaire was calculated to be 0.955 and regarding the ICC coefficient, the results showed that there was a correlation between the two answers between the two tests. The correlation coefficient of the answers in all questionnaire constructs was calculated above

Table 1. Validity of the questionnaire's questions

variable	Question number	Relativeness	CVR			CVI
			Simplicity	Clarity		Necessity
Mood	1	I fill happier than before …	100%	88.9%	88.9%	100%
	2	I fill the same as before, not so happy, not so sad …	100%	100%	100%	100%
	3	I fill more upset than usual ..	88.9%	88.9%	88.9%	100%
Energy	4	My physical activity and energy decreased …	88.9%	77.8%	77.8%	77.8%
	5	I fill the same as usual…	88.9%	100%	88.9%	77.8%
	6	I can not be as same as before and do not have enough energy to performe daily activities …	100%	100%	100%	100%
Sleep	7	I fill less likely to sleep than before …	88.9%	77.8%	77.8%	100%
	8	my sleep did not changed ….	100%	100%	100%	100%
	9	Although I fill I need to sleep but my sleeping time is unchanged …	88.9%	88.9%	88.9%	100%
Appetite	10	during previous days how is your appetite?	88.9%	100%	100%	100%
Sexual behavior	11	my sexual desire and filling are increased …	88.9%	88.9%	88.9%	100%
	12	my sexual desire and fillings are the same as before …	100%	100%	100%	100%
	13	my sexual desire and feeling has changed meaning that …	88.9%	88.9%	77.8%	100%
Lack of pleasure	14	I don't feel pleasure doing daily activities	100%	100%	100%	100%
Suicidal thoughts	15	I fill it would be better to kill myself	100%	100%	88.9%	100%
Agitation	16	I fill agitated …	100%	100%	100%	100%
Decision making	17	I can hardly make decisions …	100%	88.9%	88.9%	100%

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Table 2. Reliability of the questionnaire

Questionnaire 's main domains	Cronbach alpha	ICC	95% confidence interval	
			Lower	Upper
Mania	0.665	0.997	0.993	0.998
Depression	0.639	0.943	0.881	0.973
Total	0.955	0.966	0.917	0.981

Table 3. The pearson correlation coefficient results using test-retest method

Questionnaire's main domains	Correlation coefficient	*P* value
Mania	0.994	<0.001
Depression	0.921	<0.001
Total	0.927	<0.001

0.8; therefore, the questionnaire had acceptable reliability (Table 3). Among 30 male patients who experienced four recurrences per year, the recurrence rate decreased to an average of 2 recurrences per year after using this software.

Discussion

The present study demonstrated that BTA reduces the recurrence of symptoms in bipolar patients by 50% by using its unique questionnaire and education. Bipolar disorder is a chronic psychiatric illness with periodic nature providing various problems for patients. Acute mania attack in this disorder is one of the significant psychiatric challenges with adverse individual and social consequences requiring effective and timely diagnosis and management. Many patients with this disorder usually experience recurrent episodes throughout their lives if they do not receive proper treatment and follow-up (21). Therefore, reducing the manic episodes will decrease the treatment costs and improve various aspects of patients' personal and social life. Recent technological advances, such as the availability of computer programs and networking, have led to better control and monitoring of the treatment of many diseases (3). Symptom monitoring is one of the essential components of managing bipolar disorder (22). Researchers and physicians are currently using communication technologies to improve the management of chronic diseases such as bipolar disorder and monitor the dynamic symptoms of the disease (23). The BAT software presented in this review was the first specialized software system for screening, monitoring, and counseling manic episodes to monitor the treatment process and predict such episodes. The primary purpose of designing this system is to facilitate the process of treatment by a remote psychiatrist. Every indicator used in this system was modeled according to the American Psychiatric Association and the Health Organization standards. In a systematic review of the features and quality of the content of mobile applications for managing bipolar disorder, it has been demonstrated that the content of existing applications for bipolar disorder with practical instructions or principles of self-management does not apply. Also, the programs lacked source citation and privacy policy and did not provide the basic information needed to help users assess the quality of their illness. Therefore, both patients and physicians should be careful about choosing the appropriate programs (24).

One of the applications created in this field is the software programs for monitoring, treating, and predicting episodes of bipolar disorder (MONARCA) made by the Copenhagen Mood Disorders Center in Denmark. The application was developed in 2014. The program examines objective indicators of mood change based on correlations with physician-user ratings and predicts mood change episodes. The program used the Young Mania and Hamilton Depression Questionnaires (24). The purpose of this application is also in line with the application presented in this article, with the difference that the software program presented in this article has a valid and reliable questionnaire on the Iranian population. Besides, the self-monitoring questions used in the present software program provide daily patient monitoring. While the measurement tool used in the Monarca application is physician-based, and when the patient does not have access to the physician, information related to this area is recorded with lower accuracy.

The present research provided a Persian language self-reporting questionnaire for screening the psychological and behavioral status of bipolar patients and a web-based educational-interactive software using the questionnaire to monitor and manage the mood episodes in these patients, which could successfully reduce the mood alteration episodes in the Iranian population.

Strength and limitations

The present study was the first research on the development of a Persian language tool for the management of bipolar disorder patients and the two years follow-up for our researcher made software for online screening of bipolar patients is not sufficient for determination of long term efficacy. Therefore, longer follow up of using our application will provide more reliable evidence regarding its efficacy on management of bipolar patients. Moreover, enrolment of a larger sample size of bipolar patients will provide more information regarding the effectiveness of using BTA. One of the strengts of our study was its potential effect in management of bipolar disorder during the COVID-19 pandemic when bipolar patients may not have direct access to their caregivers.

Conclusion

The present research provided a Persian language self-reporting questionnaire for screening the psychological and behavioral status of bipolar patients and a web-based educational-interactive software using the questionnaire to monitor and manage the mood episodes in these patients, which could successfully reduce the mood alteration episodes in the Iranian population.

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Ethics

The present study has been approved by the Mashhad University of Medical Sciences Ethical Committee (IR.MUMS.MEDICAL.REC.1397.326).

Conflict of Interests

The authors declare that they have no competing interests.

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