

The Use of Smartphone for Bipolar Disorder Patients: A Systematic Review

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ABSTRACT

Bipolar is a mood disorder characterized by extreme swings between feelings of happiness and sadness. Based on WHO data, around 60 million people experience bipolar disorder. Bipolar disorder causes functional, psychosocial functioning, quality of life impairments and even the risk of suicide. The large number of smartphone users and the increasing computing power of mobile devices can be used as a reference in using smartphones for bipolar disorder. This systematic review aims to determine the use of smartphones for patients with bipolar disorder. The systematic review method was applied to search articles in electronic databases such as PubMed, Science Direct, and SpringerLink published in 2017-2021. The keywords used in the search were "smartphone", "bipolar disorder" using the Boolean "AND". Articles reviewed were those which met several inclusion criteria such as relevant to the study objective, written in English, not an article review, and free full text. An analysis towards 16 relevant articles found that the use of smartphones for patients with bipolar disorder was intended to measure and monitor signs and symptoms, as a medium for psychotherapy, and to increase adherence to medication. This can be a reference for healthcare workers in carrying out monitoring and management programs for bipolar disorder.

Keywords : *Smartphone, Bipolar, Mental Disorder.*

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INTRODUCTION

Bipolar disorder is a mood disorder characterized by extreme swings between feelings of happiness and sadness. Because of these changes, bipolar disorder is also called manic-depressive, in which the patient suffers from periods of depression but also suffers from periods of mania (excitement or irritability, excessive energy, lack of sleep, fast speech, feeling very up, poor judgment and impulsivity)¹.

Bipolar disorder occurs in many countries in the world. Based on the WHO report, there are around 60 million people affected by bipolar disorder². Individuals with bipolar show symptoms of mania, where they behave impulsively, feel invincible and often engage in risky activities such as suicide³. In addition,

neurocognitive dysfunction and depressive symptoms in bipolar disorder can lead to functional impairment^{4,5}. In addition to functional impairment, bipolar disorder also have a serious impact on psychosocial functioning and quality of life^{6,7}. Therefore, innovations are required in the management of such disorder.

The rapid development of technology is also followed by technological developments in the health sector, one of which is regarding mental health. Various technologies such as smartphones have been successfully adopted in the context of mental health⁸. There is a rapid growth of Smartphone users in Indonesia. Based on data derived from the Ministry of Communication and Information, 89% of Indonesia's population uses smartphones⁹.

There are sensors embedded in

smartphones so that they can collect a large amount of objective information to identify behavioral patterns of symptoms as well as physiological signs. Such advantage leads to the potential to provide new insights about mental disorders¹⁰. In addition, there are means to collect various sensor data on smartphones, so as to be able to capture disease-related behavioral information¹¹.

The large number of smartphone users and the increasing computing power of mobile devices can be used as a reference in using smartphones for the mental health sector, especially for bipolar disorder. This systematic review aims to determine the use of smartphones for patients with bipolar disorder.

METHOD

This article writing applied literature review method through electronic searches on several databases such as PubMed, Science Direct, and SpringerLink which were published in 2017-2021. The keywords used in the search

were "smartphone", "bipolar disorder" using the booleand "AND". The keywords used in the search were "smartphone", "bipolar disorder" using the Boolean "AND". Articles reviewed were those which met several inclusion criteria such as relevant to the study objective, written in English, not an article review, and free full text.

Article identification was performed using the PRISMA guidelines with the following steps: (1) determined the research topics to be reviewed, (2) determined research questions, (3) determined keywords for the article search process, (4) searched for articles with predefined keywords in the selected databases, (5) identified multiple articles from the databases, (6) screened relevant articles based on titles and abstracts, (7) screened full text articles using inclusion criteria (8) determined the articles to be analyzed. Figure 1 presents the search flowchart.

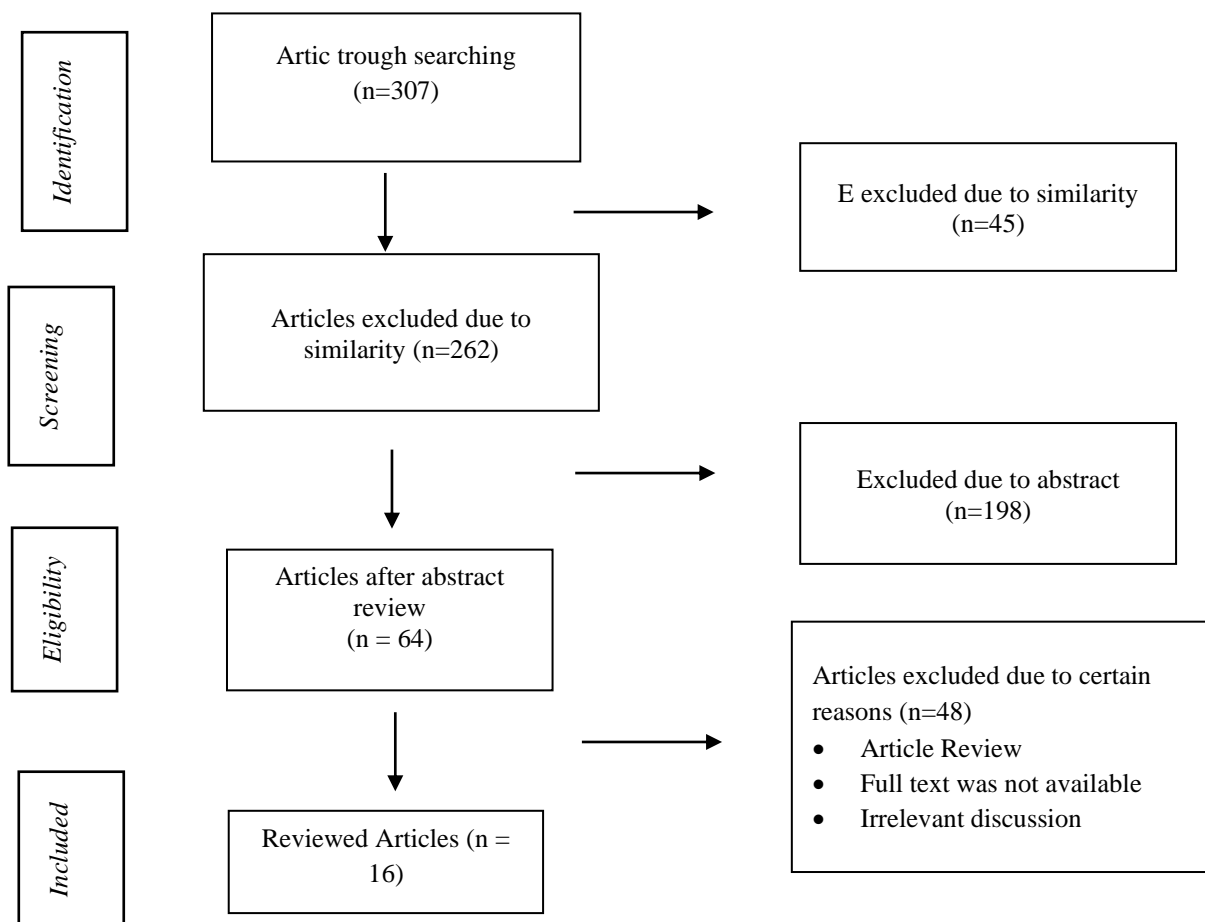


Figure 1. Article Search Flowchart

RESULTS

The database search results obtained 307 articles which were further selected. The

selection results obtained 16 relevant articles for further analysis. The results of the analysis are described in table 1.

Table 1. Reviewed Articles

Writer/Year	Study Objective	Study Design/Samples	Findings
Anand et al, (2019) ¹²	To determine smartphone-based daily and weekly mood assessment, especially among patients who took antidepressants.	Periodic mood monitoring study where respondents could record their mood daily or weekly using a smartphone application (n = 40).	Mood assessment using a smartphone could show mood instability in bipolar disorder.
Gideon et al, (2019) ¹³	To determine the mood based on an anomaly detection framework called “TemNorm”.	Longitudinal study on 51 types of bipolar disorder I and II using the PRIORI dataset which is a collection of natural conversations on smartphones.	TempNorm could detect ongoing mood disorder ratings.
Maurin et al, (2020) ¹⁴	To determine the difference in the level of adherence between patients who used BIPOLIFE® game and patients with regular treatment.	RCT by comparing the use of BIPOLIFE® game (n = 20) vs. regular treatment (n = 21).	The level of adherence of patients who used BIPOLIFE® was higher than that of patients who got regular treatment.
Fellendorf et al, (2019) ¹⁵	To assess the validity of the “UP!” to detect mood fluctuations and episodes of illness compared to clinical psychiatric interviews, validated questionnaires, and fitness trackers, and to evaluate user acceptance of the app.	Development of “UP!” app for Android smartphones, by collecting daily and continuous mood data on movement, exercise, sleep duration, and digital communication intensity via GPS and sensors among individuals with bipolar (n=24) and control (n=24) of healthy individuals without mental impairment.	Behavior pattern recognition via smartphones could provide innovative technological tools for the early detection of episodes of bipolar disorder.
Dargel et al, (2020) ¹⁶	To determine the difference between mood data that were clinically assessed and mood/behavior data collected automatically using the “Toi Mème” application among patients with bipolar disorder and to assess the feasibility of the application.	An open-label, nonrandomized trial among 93 respondents (31 depressive, 31 euthymic, and 31 hypomanic) diagnosed with type I/II bipolar disorder.	The Toi Mème app could assess Bipolar Disease Activity.
Mühlbauer et al, (2018) ¹⁷	To assess the effectiveness of smartphone-based feedback loops for detecting signs of affective episodes in bipolar disorder.	Randomized controlled single-blind trial (n=120).	Smartphone-based feedback loops could detect signs of an affective episode.
Carr et al, (2020) ¹⁸	To predict depression levels using acceleration data recorded from smartphones among individuals with bipolar disorder.	Collected acceleration data corresponding to depression scores among 52 participants over 37 weeks	Features derived from smartphone accelerometers could provide objective signs of depression

Ryan et al, (2020) ¹⁹	To assess the feasibility and usefulness of smartphones for viewing daily fluctuations in mood in bipolar disorder.	26 individuals with bipolar disorder and 12 individuals as controls were given a smartphone with a specially made application to complete questions about mood for 28 days. The app automatically and secretly collected phone usage data.	Compliance levels and positive experiences were reported when completing mood questions using a smartphone
Faurhot-Jepsen et al, (2021) ²⁰	To investigate voice features collected during phone calls as a marker of affective states in bipolar disorder by combining voice features and smartphone data about auto-generated behavioral activity.	Data were collected from 28 outpatients with bipolar disorder daily for 12 weeks.	Voice features collected using a smartphone could be used as an objective sign of bipolar disorder. Combination of voice features and smartphone data regarding behavioral activity and self-monitored electronic data could improve the accuracy, sensitivity, and specificity of affective state.
Faurhot-Jepsen et al, (2017) ²¹	To determine the effectiveness of smartphone-based monitoring and treatment system in reducing readmission rates and duration compared to standard intervention.	Randomized controlled, single-blind parallel-group design. (n=400) which involved 200 patients with unipolar disorder and 200 patients with bipolar disorder	Smartphone-based monitoring systems was proven to be effective in reducing readmission rates and duration.
Wenze et al, (2017) ²²	To evaluate the feasibility and acceptability of smartphone-based interventions in improving adherence to bipolar disorder treatment.	Eight participants completed 4 one-on-one individual therapy sessions over the course of a month, followed by 60 days of twice-daily Ecological Momentary Intervention (EMI) sessions.	Respondents showed good adherence to the intervention, including adherence to face-to-face and smartphone-facilitated sections. <i>smartphone</i> .
Pozza et al, (2020) ²³	To compare the level of adherence to antipsychotics between psycho-education provided through the Bipolar mobile application (Bip.App) and the standard psycho-education and a combination of both.	RCT	Combination of standard group psycho-education and smartphone-based psycho-education was a better choice to improve the process of monitoring and self-management of patients, thereby increasing adherence to treatment.
Fellendorf et al, (2021) ²⁴	To assess the acceptance for UP! application and to validate sleep wake times assessed with the UP! Application.	UP! App was used by 22 individuals with bipolar disorder and 23 controls. Respondents recorded the time they woke up using the UP! for 3 weeks.	UP App! Could be used to accurately measure changes in sleep duration.

Melbye et al, (2021) ²⁵	To validate automated data on smartphones which described physical, social activities and phone use among young patients with newly diagnosed bipolar disorder.	A total of 40 young patients with newly diagnosed bipolar disorder and 21 patients in the control group aged 15–25 years were assessed for daily smartphone automated data for 3-779 days.	Automatically generated data on physical and social activities and phone use reflected certain symptoms.
Jonathan et al, (2021) ²⁶	To develop a user-centric LiveWell application, a smartphone-based self-management intervention for bipolar disorder.	Hands-on trials of LiveWell consisted of a smartphone application in daily self-monitoring design sessions, usability test, and pilot study of smartphone-based self-management intervention for bipolar disorder.	This app went through several revisions during the user-centric development process.
Busk et al, (2020) ²⁷	To test the feasibility of a mood score prediction application based on self-assessments collected daily from patients through a smartphone-based system.	RCT (n=84)	Self-assessment method through a smartphone-based system could predict mood for several days with low error compared to general basic method.

DISCUSSION

Various smartphone applications that have been developed showed that there were creative information technology-based innovations that were useful for patients with bipolar disorder. Each of these applications had useful features such as measuring and monitoring signs and symptoms, as a medium for psychotherapy, and increasing adherence to medication.

Measuring and Monitoring Signs and Symptoms

The heterogeneity of symptoms of bipolar disorder makes it difficult to predict the course of the disease. As a result, patients often lack knowledge and are often unaware of the mood swings that lead to relapses²⁸. To prevent this, accurate information about the timing of the affective phase transition must be made available to patients and healthcare professionals. This information can enable service providers to intervene as soon as symptoms appear.

Information from the patient's daily life can help provide earlier and more reliable predictions of the affective phase transition that will occur in bipolar disorder¹⁷. Smartphones are easy-to-use and low-cost devices that can be used to assess information in patients' daily environment¹³. In addition, there is great interest among patients with

mental health problems in monitoring symptoms through mobile applications²⁶.

Applications on smartphones could record and process behavior related to accelerometers, global positioning systems (GPS), exercise, physical activity, sleep, work and leisure time, phone calls, and digital communications^{15,18,20,24,25}. Interpretation and statistical analysis of data could be carried out by the application system, so that it might lead to more personalized diagnoses and interventions²⁹.

As a Medium for Psychotherapy

Psychotherapy is the first-line intervention to prevent relapse in bipolar disorder³⁰. However, there are several obstacles to the success of therapy. One of the main problems is the nature of face-to-face therapy which requires the patient and therapist to be at the same time. It requires a strong commitment to such care making it difficult for many patients, especially since therapy is given over a long period of time (eg, 4-6 months) and sessions take place at fixed dates and times (eg, once a week, lasting 1 hour)³¹. Such characteristics of therapy caused the high dropout rate. In addition, to implement certain intervention programs, there should be specialized therapists and there was a gap between supply and demand³², and hence in many health systems, the provision of

such care was limited³¹.

Information and communication technology is an opportunity to develop smartphone-based psychotherapy. This technology can overcome some of the limitations of face-to-face care. Smartphone-based psychotherapy is easily accessible and the time for therapy can be adjusted according to the needs and availability of each user²³. In addition, such intervention programs offer the possibility of patient self-monitoring with two-way feedback between the patient and the healthcare provider²⁶.

Smartphone-based psychotherapy in the form of learning sessions contained multimedia content such as video tutorials, presentations, audio, and pdf documents as well as psychotherapy exercises that could be performed anytime and anywhere^{23,26}. In addition, smartphone-based psycho-education provided a way to remotely monitor patient status by enabling the collection of physiological/biometric parameter data so that patients could be actively involved in the treatment process²³.

Improving Adherence to Medication

A previous study showed that half of patients with bipolar disorder did not take their medication as prescribed⁽³³⁾. Low level of adherence increase the risk of mood swings, cognitive impairment, depressive sequelae, suicide, as well as increased use of health care and poor quality of life^{33,34}.

Several things that hinder patient non-adherence to treatment were costs and accessibility of health care³⁵. One potential strategy to increase adherence to and also increase the accessibility of treatment is intervention using a smartphone. Several previous studies revealed that applications on smartphones such as BIPOLIFE® and EMI could improve adherence to medication and attitudes toward treatment^{14,22}.

Applications on smartphones could increase adherence through psychoeducational messages and also through observation on the consequences of changes in mood and energy in the form of avatars. Some patients reported that such features helped them realize the importance of the quality of life and adherence to medication in the management of bipolar disorder^{14,22}.

CONCLUSION

Smartphones could be used for bipolar disorder patients for certain functions such as measuring and monitoring signs and symptoms, as a medium for psychotherapy, and increasing adherence to medication. This can be a reference for healthcare workers in carrying out monitoring and management programs for bipolar disorder.

CONFLICTS OF INTEREST

The authors declare no conflict of interest.

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