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Mobile Applications in Mental Health: A Systematic Review of Efficacy

Ruh Sağlığında Mobil Uygulamalar: Etkinliğe Yönelik Sistematik Bir Gözden Geçirme

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Abstract

In recent years, the number of smart phone applications developed for physical and mental health has been rapidly increasing. The rapid growth in the use of smart phone applications provides an alternative and supportive option for the treatment of mental illnesses. The aim of this systematic review is to investigate the effectiveness of mobile applications related to mental health by using randomized controlled trials (RCTs). Within the scope of the study, English articles published in several databases were searched using specific terms. Twelve eligible studies fulfilling the research criteria were evaluated in terms of contents, sampling, study method and findings of the applications. The findings of the current studies revealed that mobile applications are generally effective in reducing the symptoms of the mental illness and feasibility and usability of smart phone applications were reported by participants.

Keywords*:* Smart phone, mobile applications, mental health.

Öz

Son yıllarda fiziksel ve ruhsal sağlığa yönelik geliştirilen akıllı telefon uygulamalarının sayısı hızla artmaktadır. Kullanımı hızla yaygınlaşan uygulamalar ruhsal rahatsızlıkların tedavisine alternatif ve destekleyici bir seçenek sunmaktadır. Bu derlemenin amacı, ruh sağlığı ile ilgili mobil uygulamaların etkinliğini randomize kontrollü çalışmalar (RKÇ) ile değerlendiren alanyazındaki çalışmaları sistematik olarak gözden geçirerek incelemektir. Çalışma kapsamında çeşitli veritabanlarında yayınlanan İngilizce makaleler belirlenen anahtar kelimeler kullanılarak taranmıştır. Yapılan tarama sonucunda dahil etme kriterlerine uygun 12 araştırma bu çalışmaya dahil edilmiştir; bu çalışmalar ise uygulamaların içeriği, örneklem, çalışma yöntemi ve bulgular açısından değerlendirilmiştir. Çalışmalardan elde edilen bulgular ışığında mobil uygulamaların genel olarak hedeflenen ruhsal bozukluk belirtilerini azaltmada etkili olduğu ve katılımcılar tarafından uygulamaların benimsendiği ve kullanımının kolay olduğunu rapor ettikleri görülmüştür.

Anahtar sözcükler: Akıllı telefon, mobil uygulamalar, ruh sağlığı.

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TODAY, smartphones have become a part of personal, social and professional life for large numbers of people worlwide. It is known that there are 4.3 billion mobile phone users in the world (Sourcedigit 2012). Furthermore, the average users check their phones about 150 times a day (Meeker 2014). Hence, with the ease of access to smartphones and the internet, mobile applications have the potential to reach large numbers of people all over the world, and as such are an indispensable part of life.

In recent years, it is noteworthy that the use of mobile applications for health and well-being has increased dramatically (Riley et al. 2011). The rapid development and use of health-related smartphone applications offers an alternative and supportive option for reducing symptoms of mental illness. It is estimated that more than 165,000 smartphone applications related to physical and mental health are now available (Misra 2015). The study in Australia shows that 76% of the participants would be interested in using mental health related phone application (Proudfoot et al. 2010). Therefore, such applications may be acceptable to society and can be used as an useful tool. Applications related to mental health can also be used as an independent self-help program or as a combined treatment method as part of an ongoing treatment. Such applications usually involve therapy components such as psychoeducation, mindfullness, behavioral activation, and meditation.

26% of people experience mental disorder during their lifetime; however, only 30-40% of them seek treatment (Regier et al. 1998). The most common barriers are treatment costs, beliefs regarding psychological treatment, and fear of negative stigmatization by the society (Kessler 2005, Vogt 2011). It is also known that help seeking behaviors of younger and ethnic minority individuals are more limited (Gavrilovic et al. 2005). In addition, there are not enough mental health workers to meet the needs in many places (Kazdin and Rabbitt 2013). For these reasons, alternative methods are needed that can help reduce symptoms of mental illness. It is argued that health-related smartphone applications have the potential to be an important part of the health system (Watts 2013), as it makes mental health services more accessible and reduces the barriers to help seeking behaviors.

With the widespread use of smartphones, the use of mobile applications in our lives is expected to incrase. However, the content of these applications is not prepared under certain guidelines and standards. Therefore, the number of studies should increase to remove uncertainities about its effectiveness. The studies examining the efficacy of smartphone applications for mental disorders indicate that applications may be effective in the treatment of different mental disorders such as depression, posttraumatic stress disorder and agoraphobia (Arean et al. 2016, Christophore et al. 2017, Kuhn et al. 2017). However, the rapid development of smartphone applications in the mental health area requires a systematic investigation. The limited systematic studies in this area examined the effect of all online-based (SMS or website) applications, but not just mobile applications. For example, the systematic study conducted by Ehrenreich (2011) included telephone interviews, technological applications such as SMS, e-mail, and tablet in assessing the effectiveness in treatment of smoking addiction and anxiety disorders. Furthermore, it is noted that limited number of the studies included randomized controlled trial (RCT) design. Donker et al. (2013) examined whether smartphone applications are effective in reducing symptoms of stress, anxiety, depression, and substance use disorder. In this comprehensive systematic study, a total of 8 studies with

and without RCT was included. It was found that the applications were effective in the treatment of depression, stress and substance abuse. On the other hand, systematic reviews that only include RCT studies are needed in order to provide more controlled evidence in the field. Indeed, this need becomes even more meaningful when it is considered that the RCTs are highly validated internally and that participants randomly assigned to the intervention and control groups and that they include the most rigorous and objective methodology to assess intervention outcomes (Kendall et al. 2013). Another important feature that distinguishes the current study from existing systematic review is that instead of focusing specifically on just one disorder, it includes studies which assess the effectiveness of mobile applications for different disorders within the framework of standards. In this context, the main purpose of this study is to provide a systematic review of the methodically more reliable and broader framework.

Method

In this study, articles published in English in EBSCO, APA, Web of Science, and PubMed (MEDLINE) databases were scanned without a specific date criterion, in order to assess the effectiveness of smartphone applications used in the treatment of psychological disorders in adults. Search terms included 'mental illness' or 'mental disorder' or 'mental health' and 'smartphone' or 'mobile app' and 'RCT' or 'randomized control trial'. Non-RCT studies, computer-based studies, non-results studies, sampled children and adolescents, study protocols, systematic reviews and meta-analysis studies were excluded from the review (Figure 1).

There were 12 articles eligible for inclusion. The selected studies were evaluated in terms of sample characteristics, targeted mental illness, the duration of the applications, the scales, control groups, the number of participants in the groups, and measurement times..

Results

Participants

Across all studies, the participants are older than 18 years and the sample size is changed between 20 (Possemato et al. 2017) and 626 (Arean et al. 2016). In 9 studies, the sample was female-weighted at varying rates ranging from 57% (Christoforou et al. 2017) to 85% (Arean et al. 2016). One study conducted by Bucci et al. (2018) has the equal number of female and male participants (the characteristics of the studies evaluated in this review are presented in the Table 1 in alphabetic order).

All of the studies were of RCT design. The participants have different mental disorders: major depressive disorder (n=5), bipolar disorder (n=1), PTSD (n=3), agoraphobic disorder (n=1), eating disorder (n=1), psychosis (n=1). Another remarkable aspect of the review is that the studies are fairly up-to-date (all articles published in the period between 2013 and 2017). This suggests that the interest of mobile users as well as the interest of researchers has increased in recent years and that more study will be conducted on mobile applications in the future.

Experiment and Control Groups

Participants were assigned to the experiment and control group randomly at all studies

examined in this review. Furthermore, all studies included various types of control groups and the efficacy of the applications was evaluated by comparing the data obtained from pre-test, post-test and follow-up measurements. Specifically, the applications of these 12 studies, RCTs involved, were compared with another Internet-based application or another mobile application that was evaluated as effective (Watts et al. 2013, Ly et al. 2014, Arean et al. 2016, Christoforou et al 2017, Hildebrandt et al 2017, Possemato et al. 2017, Bucci et al 2018); 3 studies included waiting list control group (Miner et al. 2016, Kuhn et al. 2017, Tighe et al. 2017). In one study, medication therapy was used as a control group (Mantani et al. 2017). Faurholt-Jepsen et al. (2015) used the most different control group: participants in the control group were asked to use only a smartphone that they could make phone calls with no application.

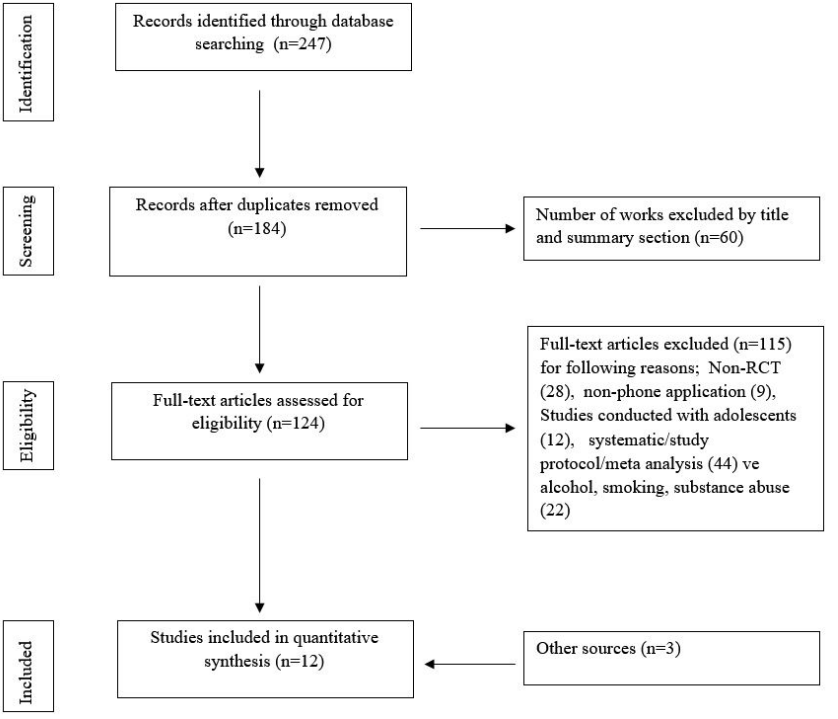

Figure 1. PRISMA decision tree

Table 1. Studies in the systematic review

Author/Year	Participants	Intervention Groups	Control Groups	Target disorder	Süre duration	Outcome Measures	Results
Arean et al. (2016)	n= 626 Average age= 33,9 (>18) Female/Male (%80-%85)	EVO (n= 209)	Health Clue (n=206) iPST (n=211)	Mild Moderate Depression	12 weeks	Every week for the first 4 weeks,8th week,12th week PHQ-9, SDS GAD-7, AUDIT-	EVO and IPST were found to be more effective at mild moderate depression levels than

						C	health-clue control condition
Bucci et al. (2018)	n=36 Average age = 19 Female/Male (%50-%50)	Actissist (n=24)	ClinTouch (n=12)	Early psychosis	22 weeks	Pre-test,post-test, 22 weeks follow-up PANSS, PSYRATS, GAF ERS, EQ-5D-5L TLFB, MARS	Actissist application was found to be feasible, safe and effective in reducing depressive syptoms
Christoforou et al. (2017)	n=142 (>18) Average age.:40 Female/Male(%57/ %43)	Agoraphobia Free (n=73)	Stress Free (n=69)	Agoraphobia (Based on individual descriptions)	12 weeks	Pre-test, 6th week, 12th week PAS	Statistically significant improvement in symptom severity was observed in both groups. There was no significant difference between the groups.
Faurholt-Jepsen et al. (2015)	n=78 (18-60) Average age = 29.3 Female/Male (%65-%35)	MONARCA (Mobile-based) (n=39)	MONARCA mobile phone without application (n=39)	Depressive and panic symptoms in bipolar	6 months	Pre-test, monthly measurements, 6 month follow-up HAMD-17, YMRS, PSS, FAST,WHOQOL MDI, ASRM, MASS, SCIP-S.	Even thought the overall effect of MONARCO was not significant, the symptoms of participants with manic symptoms improved.
Kuhn et al. (2017)	n=120 Average age = 39 (>18) Female/Male (%69,2-%30,1)	PTSD Coach (n=62)	Waiting list (n=58)	PTSD	12 weeks	Pre-test,post-test, 3 month follow-up PCL-C, PHQ-9 BIPH, LICL	A significant improvement was observed in the PTSD symptoms and psychosocial functioning in participants using PTSD Coach compared to control group.
Ly et al. (2017)	n=81 Average age 36 Female/Male (%70- %30)	BA (Behavior-al Activation) (n=41)	Mindfulness (n=40)	Depression	8 weeks	Pre-test, Post-test, 6 month follow up BDE, BAI QOLI, AAQ	There was no significant difference between the two interven-tion applica-tions. However, for participants with a higher level of depression, BA was found superior to

							Mindfullness therapy. For participants with lower depression severity, Mindfulness therapy provided significantly better outcomes than BA.
Mantani et al. (2017)	n=164 Average age 40.1 Female/Male (%58- %42)	Kokoro App. (n=81)	Only the drug is changed (n=83)	Depression	17 weeks	PHQ-9 BDI-II Frequency, Intensity, and Burden of Side Effects Ratings (FIBSER).	BDI and FIBSER scores were found to be lower in the 9th week of the app. users. It has been observed that the treatment benefits lasted until the 17th week.
Miner et al. (2016)	n=49 Average age = 45.7 Female/Male (%81,6- %18,4)	PTSD Coach (n= 25)	Waiting list (n=24)	PTSD	4 weeks	Pre-test,post-test, 1 month follow-up PTSD checklist	PTSD Coach application has been found to be an easy to implement and acceptable application.
Tighe et al. (2017)	n=61 Average age = 26.25 Female/Male (%46,1- %63,9)	iBobbly (n=31)	Waiting list (n=30)	Thought of depression and suicide	6 weeks	Pre-test,post-test, 6 months follow-up PHQ-9 DSI, K10 BIS	İbobbly application was found to be effective in reducing the level of psychological distress and depression; however, did not significant-ly reduce suicidal thoughts and impulsivity.
Hildebrandt et al. (2017)	n= 66 Average age 30.33 Female/Male (%72 - %28)	CBT -based self-help practices (n=33)	NOOM (A smartphone application) (n=33)	Binge ating and bulimia nervosa	12 weeks	The measure-ments were collected at 0, 4, 8, 12, 24 and 36 weeks. BDI, EDE HRQ, OBE	A significant impact has been seen in OBEs of smartphone users. Remission measurements were not statistically different between treatments.

							The treatments did not show any difference at 6 months follow up.
Possemato et al. (2017)	n=20 Average age 42 Male/Female (%95-%5)	Clinician-Supported PTSD Coach (n=10)	Self-Managed PTSD Coach (n=10)	PTSD	8 weeks	Pre-test, post-test, 12th week and 16th week follow-up PCL-S, PHQ-9 WHO-QOL	Clinician-Supported and Self-Managed PTSD Coach have been found to be feasible and useful. However, Clinician-Supported PTSD Coach app. has been found to be more effective in reducing the symptoms.
Watts et al. (2013)	n=35 Average age 41 (18 - 63) Female/Male (% 80- %20)	Get Happy (Mobile App) (n=15)	Get Happy (Web Based) (n=20)	Majör Depression	8 weeks	Pre-test, 4th week post test (1 week after the last lesson) , 3-month follow-up. PHQ-9, BDI K-10, CEQ ERS, SDS	Both mobile and web based applications provide statistically significant benefits. Three-month follow-up, has been preserved in a reduction in symptoms in both groups.

Content of Applications

The content of applications assessed in studies, it appears that a great majority is structured based on Cognitive Behavioral Therapy (eg, Watts et al. 2013, Christoforou et al. 2017). In addition, behavioral activation approach (Ly et al. 2017, Mantani et al. 2017) was used in 2 studies and game-based CBT techniques were used in 2 studies (Arean et al. 2016, Christoforou et al. 2017). The most commonly used technique in applications is psychoeducation. Eight studies included psychoeducation with basic knowledge of the targeted psychiatric disorder (Kuhn et al. 2017, Tighe et al. 2017, Bucci et al. 2018). Some of the studies also included guidelines for the practice of relaxation, breathing and mindfulness exercises (Miner et al. 2016, Kuhn et al. 2017, Possemato et al. 2017, Bucci et al. 2018). Nearly all of the studies have contact information for individuals with similar psychological disorders or immediate communication resources in crisis situations. While most of the applications are based on self-help, there are only two direct contacts with a health worker (Fourholt et al. 2015, Possemato et al. 2016). For example, in the study conducted by Fourholt et al. (2015), the user is required to regularly enter the self-monitoring system with information such as emotional state, sleep duration, medication intake, daily activity level, and alcohol consumption. The data entered by the user are followed up by health professionals at the clinic to communicate

with the user about the precautions that can be taken when depressive or manic symptoms occur (such as reducing or increasing the level of coping strategies or activity).

Measuring Instruments and Measurement Times

In all studies included in the current study (12 studies), measurements were based on self-report scales. In the six of the studies, Patient Health Questionnaire (PHQ-9) was used in common. Besides, the scales used in the studies can be listed as follows: Psychological Distress Scale (K10), PTSD Checklist—Civilian (PCL-C), Brief Inventory of Psychosocial Functioning (B-IPF), Life Events Checklist, Beck Depression Inventory (BDI), Beck Anxiety Inventory (BAI), Quality of Life Inventory (QOLI), Acceptance and Action Questionnaire (AAQ),Depressive Symptom Inventory- Suicidality Subscale (DSI-SS), Barratt Impulsivity Scale (BIS), Panic and Agorafobia Scale (PAS), Sheehan Disability Scale (SDS), Generalized Anxiety Disorder 7-item scale (GAD-7), Alcohol Use Disorders Identification Test (AUDIT-C), World Health Organization Quality of Life (WHO-QOL), Cohen's Perceived Stress Scale (PSS), Functioning Assessment Short test (FAST).

Pre-test, post-test and follow-up measurements were taken from the participants in all of the studies included in the current review. The follow-up period ranged from 1 month (Miner et al. 2016) to 9 months (Hildebrandt et al. 2017). The duration of the treatments ranged from 4 weeks (Miner et al. 2016) to 6 months (Faurholt-Jepsen et al. 2015)..

Results of Studies

When the effectiveness of mobile applications in different mental disorders is evaluated; it has been found that mobile applications are effective in reducing the symptoms of targeted mental disorders in general. For example, in the study conducted by Kuhn and his collegues (2007), when compared to the control group, a significant improvement was found in PTSD symptoms, depression severity, and psychosocial functioning of the participants who used the evaluated application. However, in some studies, it was observed that the evaluated application was not effective enough to reduce the indication of the targeted impairment but was effective in reducing some other problems. For example, Tighe et al. (2017) reported that the application developed for suicide was effective in reducing psychological distress and depression whereas it was found to have no significant effect on reduction in suicidal thoughts and impulsivity. This result reveals the difficulty of resolving severe symptom levels via self-help practices and leads to the idea that the conformity of mobile applications should be determined according to the severity of symptoms and problems.

In the literature, some studies were found to compare two different applications (Watts et al. 2013, Christoforou et al. 2017, Ly et al. 2017, Possemato et al. 2017). Although, no significant difference between the two applications was indicated in some studies (Watts et al. 2013, Christoforou et al. 2017, Ly et al. 2017), Possemato et al. (2017) reported a significant difference between two forms of the same application in their study. When the clinician supported and non-clinician supported forms of the same application were compared; the clinician supported application practice was found to be significantly better in reducing symptoms of PTSD. In another study conducted with participants diagnosed with depression, the 'drug condition' was compared to the

'drug and application condition' (Mantani et al. 2017). The participants who used the application reported a reduction in the severity of their symptoms compared to those who did not use the application and this effect lasted for 17 months, as well.

In the studies, it has been reported by participants that the applications are easy and adoptable in general. Although the studies seem to be focused on particular diagnosis (such as PTSD, major depressive disorder, suicidal thought, eating disorders, schizophrenia disorder, bipolar disorder and agoraphobic disorder), these methods seem promising for a range of mental disorder. The duration of applications conducted in the studies was found to range between 6 weeks to 9 months. When the high cost of psychological treatments is taken into account, it is anticipated that as the mobile applications becomes widespread and be used as a suppotive tool, the money and the time spent on healthcare for treatments will also be reduced.

Along with the findings, in Turkey, the absence of a scientific study on this issue is noteworthy. This case shows limited use of technological interventions in the treatment of mental disorders in our country. This can be explained by the fact that more traditional treatments are preferred in Turkey. Although scientific studies have not been conducted yet, it is exciting to see that some new applications for psychological disorders are emerging in our country, as well.

Discussion

With the rapid growth of technology, the use, diversity, accessibility and acceptability of smartphones and applications are increasing day by day. The statistics provided by the App Annie research company for the third quarter of the year indicate that applications in stores have been downloaded 26 billion times and this number reflects the first/new downloads (www.appannie.com). At the same time, the increasing use of smartphones and free or low-cost applications make applications easy to access. Applications generally focus on the self-monitoring and on the changes in indivuduals' himself. The rapid increase in the number of smart phone applications in the field of physical and mental health also brings the question of effectiveness into the mind. For this reason, researchers and users are increasingly paying more attention to the studies that assess the effectiveness of these applications. Taking this information into account, it is considered that it is important to systematically review studies that examine the effectiveness of applications developed for mental disorders. For this reason, distinct from the other studies, the current study systematically reviewed the RCTs studies which determined the efficacy of smartphone applications developed for various mental problems.

In the articles included in the current study, it was observed that the gender distribution of the sample was unbalanced (women in majority). The sample sizes vary according to the study, whereas it consisted of 20 participants at least (Possemato et al. 2017). Moreover, since the mental disorders are different from each other, different measurement instruments are being used in the studies. However, the inclusion of only RCTs designed studies for the current review ensures that all studies have pre-test, post-test and follow-up process. The current systematic review revealed that although the size of the sample, measurement times, measurement instruments and disorders varied, mobile applications were found to be as effective as other applications or more effective than waiting control group. For individuals who do not have symptoms with severe risk, it seems to be effective to include the clinician-assisted or non-assisted

applications in their daily life as a preventive system. Briefly, since mobile applications are generally found to be effective, these applications can be used as a supportive tool in mental health.

In the studies included in the current review, the evaluated applications had different contents or different underlying treatment orientations. For example, the absence of a standard for contact to the therapist should be taken into account especially while studying with high risk groups (suicidal thoughts, major depression, etc). From this point of view, it is considered to be important to establish a standard for the content of applications emerged in the future. Therefore, one of the issues that need to be addressed in the future is that some of these applications will only include self-help and psychoeducation. Another issue is when, what problems, in which situations, therapist help is needed and how to access the therapist. There seems to be a need of further study and evaluations on these issues.

On the other hand, the content of mobile applications allows the individual to monitor himself / herself and to notice his / her changes early. As a consequence, it is thought that the search for help may emerge in a relatively earlier period. It can be considered that such an increased awareness may be useful in early diagnosis or intervention whereas the need for new practices and studies on these issues are stil needed. The applications are also beneficial for individuals with mental problems since they can access these applications easily and economically. Especially when face-to-face contact with the therapist is not possible or when the individuals do not want to consult to a specialist for many reasons, especially stigmatization; the applications support individuals to change themselves with simple and narrow extended interventions while reducing the potential workload of mental clinics/specialists (Winslow et al. 2016). Moreover, as mentioned earlier, certain standards are needed in this field in conjunction with the increase number of such applications. In this context, the first examples have begun to show themselves. For example, a free project project called Psyberguide evaluates, classifies and grades mental health-oriented smartphone applications offered on the market within specific standards (www.pysberguide.org). It is also known that in some universities, academicians have contributed to the current process by developing laboratories, devising applications and addressing their effectiveness. Therefore, it is anticipated that such studies will become more common.

However, in addition to these advantages, according to a research, more than 80% of people uses only 5 applications in their smartphones. It is also known that the proportion of users who use an application more than 11 times is only 36 percent (Localytics 2017). However, other disadvantages of using mobile applications in mental health are the battery problems or the technical problems associated with the security and sustainability of the connections (Burns 2011). In addition, key components of therapy such as confidentiality of data, client confidentiality and timing of crisis interventions may be harmed (Luxton 2011). For this reason, such possible negative consequences should be considered in the therapy process in which mobile applications are involved. It is thought that mobile applications can be used especially when regular face-to-face consultation with the therapist is not possible or can be used as a supportive tool after the end of the treatment. In the light of this information, it seems necessary to increase the availability of developed or developing applications.

Conclusion

Mobile applications are becoming more common in the lives of individuals from day to day. Considering the advantages and disadvantages of the mobile applications as mentioned above, the fact that mobile applications have been effective in many studies to reduce the symptoms of mental disorders shows that these applications can be used as supporting tools in the mental health field. However, it is important to note that the success of mobile applications in reducing symptoms is closely related to its well-structured content and the level of the disorder. In this sense, it is considered that further well-designed research studies are needed in the literature.

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