Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

Elsevier hereby grants permission to make all its COVID-19-related research that is available on the COVID-19 resource centre - including this research content - immediately available in PubMed Central and other publicly funded repositories, such as the WHO COVID database with rights for unrestricted research re-use and analyses in any form or by any means with acknowledgement of the original source. These permissions are granted for free by Elsevier for as long as the COVID-19 resource centre remains active.
Review article

An analysis on self-management and treatment-related functionality and characteristics of highly rated anxiety apps

Nidal Drissi\textsuperscript{a,b}, Sofia Ouhbi\textsuperscript{a,s}, Mohammed Abdou Janati Idrissi\textsuperscript{b}, Mounir Ghogho\textsuperscript{c}

\textsuperscript{a} Dept of Computer Science & Software Engineering, CIT, UAE University, Al Ain, UAE
\textsuperscript{b} ENSIAS, Mohammed V University in Rabat, Rabat, Morocco
\textsuperscript{c} TICLab, International University of Rabat, Rabat, Morocco

ARTICLE INFO

Keywords:
- M-health
- Mobile mental health
- Anxiety
- Mobile apps
- Mental health

ABSTRACT

Background and objective: Anxiety is a common emotion that people often feel in certain situations. But when the feeling of anxiety is persistent and interferes with a person's day to day life then this may likely be an anxiety disorder. Anxiety disorders are a common issue worldwide and can fall under general anxiety, panic attacks, and social anxiety among others. They can be disabling and can impact all aspects of an individual's life, including work, education, and personal relationships. It is important that people with anxiety receive appropriate care, which in some cases may prove difficult due to mental health care delivery barriers such as cost, stigma, or distance from mental health services. A potential solution to this could be mobile mental health applications. These can serve as effective and promising tools to assist in the management of anxiety and to overcome some of the aforementioned barriers. The objective of this study is to provide an analysis of treatment and management-related functionality and characteristics of high-rated mobile applications (apps) for anxiety, which are available for Android and iOS systems.

Method: A broad search was performed in the Google Play Store and App Store following the Preferred Reporting Items for Systematic reviews and Meta-Analysis (PRISMA) protocol to identify existing apps for anxiety. A set of free and highly rated apps for anxiety were identified and the selected apps were then installed and analyzed according to a predefined data extraction strategy.

Results: A total of 167 anxiety apps were selected (123 Android apps and 44 iOS apps). Besides anxiety, the selected apps addressed several health issues including stress, depression, sleep issues, and eating disorders. The apps adopted various treatment and management approaches such as meditation, breathing exercises, mindfulness and cognitive behavioral therapy. Results also showed that 51% of the selected apps used various gamification features to motivate users to keep using them, 32% provided social features including chat, communication with others and links to sources of help; 46% offered offline availability; and only 19% reported involvement of mental health professionals in their design.

Conclusions: Anxiety apps incorporate various mental health care management methods and approaches. Apps can serve as promising tools to assist large numbers of people suffering from general anxiety or from anxiety disorders, anytime, anywhere, and particularly in the current COVID-19 pandemic.

1. Introduction

Anxiety is defined as “an emotion characterized by feelings of tension, worried thoughts and physical changes like increased blood pressure” [1]. Anxiety is a common feeling that a person might experience now and then when facing certain situations: for example, when taking a test, giving an interview, making an important decision or speaking in public. Such situations may bring on feelings of nervousness, worry, and fear. These context specific feelings usually disappear once the stressful situation has passed. But if these feelings of anxiety are intense, continue over a long period of time, and interfere with a person’s day to day life, then they are most likely linked to an anxiety disorder [2]. Anxiety disorders are common emotional disorders. In 2017, 3.76% of the global world population was reported to have suffered from an anxiety disorder. This percentage has almost not changed since 1990 [3]. There are several types of anxiety disorders,
including: panic disorders, phobias, social anxiety disorder, obsessive-compulsive disorder (OCD), separation anxiety disorder, illness anxiety disorder, and post-traumatic stress disorder (PTSD) [2]. Depending on the severity of the condition, symptoms and complications might include increased heart rate (HR) and blood pressure (BP), rapid breathing or shortness of breath, feeling faint or dizzy, dry mouth, sweating, restlessness, trouble concentrating, difficulty falling asleep and numbness or tingling in the body [2]. Anxiety disorders can be disabling and can interfere with the individual’s daily life, affecting their work, education, and relationships [4,2].

The exact causes of anxiety disorders are still unknown. According to the National Institute of Mental Health, it is likely to be a combination of genetic and environmental factors [5]. Other possible factors that can lead to susceptibility include brain chemistry, personality type, exposure to certain mental and/or physical disorders, trauma and stress [6]. The COVID-19 outbreak, in addition to being a public health emergency, is also affecting mental health in individuals on a global scale causing people to suffer from stress, anxiety, and depression [7,8]. The pandemic is also triggering feelings of fear, worry, sadness, and anger [9,10]. Quarantines, self-isolation, fear of the unknown, loss of freedom and other factors are causing psychological issues in people around the world [11,12]. These situations and circumstances can trigger several anxiety disorders, mainly separation anxiety disorder which is defined as fear of being away from home or loved ones, illness anxiety disorder which is defined as anxiety about a person’s health (formerly called hypochondria) [2] and panic attacks that are affecting a large number of people because of excessive worrying. Psychiatric patients are additionally at a higher risk of experiencing symptoms related to psychological issues caused by the pandemic [13]. People with preexisting anxiety disorders are showing aggravation of their conditions, for example, many people with OCD are developing new fixations on the COVID-19 virus and are experiencing compulsive cleaning [9].

Due to the COVID-19 pandemic, social interactions have significantly decreased in several parts of the world. While this may have provided relief to some people with social anxiety, it is possible this lack of interaction may have negative consequences in the longer term [14]. Returning to work after a period of lockdown, while still in the state of pandemic, is also causing the workforce to exhibit symptoms related to PTSD, stress, anxiety, depression and insomnia [15]. The current COVID-19 situation is also affecting the mental well-being of health care workers, who are at a high risk of psychological distress [16], especially those who are experiencing physical symptoms [17]. The situation is further worsened by the recommended avoidance of in-person contact and fear of infection, as people with anxiety and other mental disorders might not be able to consult with a mental health professional.

There are various barriers to mental health care delivery, such as cost, stigma, lack of mental health care professionals, and distance from health care services [18,19]. Mobile mental health or m-mental health, which uses mobile technologies for providing mental health services, has the potential to help overcome mental health care delivery barriers, as it provides anonymous access to care, low to no cost care, and remote communication. Smartphones can be a convenient tool to reach a large number of people from different parts of the world. There are many mobile applications (apps) for mental health problems such as PTSD [20,21], stress [22], depression [23] and alcohol dependence [24], as well as other health issues such as obesity, that apps can help with, especially due to lack of exercise during circumstances similar to the current lockdown [25]. Smartphone apps have high rates of acceptance among the general public, and especially in young people [26] due to its cost effectiveness [27]. Many studies have reported that apps have shown positive results in the treatment and management of anxiety [28–30].

This study aims to analyze the functionality and characteristics of highly rated anxiety apps to identify users’ preferred features and management methods delivered for anxiety with a smartphone or a tablet. For the purposes of this study, only free apps were selected, as recent statistics in March 2020 showed that 96.3% of Android apps and 90.84% of iOS apps were freely available worldwide [31]. A total of 167 apps, 123 Android apps, and 44 iOS apps were selected. The anxiety management approaches used in these apps among other aspects of functionality have been extracted and analyzed.

2. Methodology

This section presents the methodology that was followed in order to select and analyze Android and iOS anxiety apps.

2.1. Review protocol

This paper follows the quality reporting guidelines set out by the Preferred Reporting Items for Systematic reviews and Meta-Analysis (PRISMA) group to ensure clarity and transparency of reporting [32].

2.2. Sources and eligibility criteria

Google Play repository and the App Store were used as sources to select anxiety apps. Both app repositories are very popular with a high number of available health care apps: more than 41,377 apps are available in the Google play store, and more than 44,384 apps are available in the App Store [33]. A general search string, composed of only one word “anxiety”, was used. It was automatically applied to the titles and descriptions of Android and iOS apps.

Each app from the search result was examined by the first author to decide whether or not to be included in the final selection. The second author revised the final apps selection. The following inclusion criteria (IC) were applied:

- **IC1:** Anxiety related apps in Google Play Store and App store.
- **IC2:** Apps that have a free version.
- **IC3:** Apps that have 4+ stars rating.

IC3 reflects a level of user satisfaction with the app. The focus is on highly rated anxiety apps so as to discover the functionality features and characteristics that provide high user satisfaction. The following exclusion criteria (EC) were applied to the candidate apps to identify the final selection that would be included in this study:

- **EC1:** Apps that have less than 5 raters.
- **EC2:** Apps that could not be installed.
- **EC3:** Apps that crashed and could not be used after installation.

Apps that match any of the EC were excluded from the selection. EC1 is based on the heuristic guideline by Nielsen [34], which recommends having five evaluators to form an idea about the problems related to usability.

2.3. Anxiety apps selection

The apps’ selection process was established as follows:

1. The search string was used to identify candidate apps in the Google Play Store and App Store in order to create a broad selection from
which to choose from.
2. IC were used to identify relevant apps.
3. Apps that met one or more of the EC were excluded.

The above actions were carried out in March 2020. A final selection of 123 Android apps and 44 iOS apps was identified after application of IC and EC. Fig. 1 presents the selection results.

2.4. Data extraction strategy

Data collection was carried out using the data extraction form presented in Table 1. Each app was installed and assessed to explore its functionality features and characteristics. The devices used for the apps’ assessment were: OPPO A9 (Android 9), and iPad 3 (iOS 13). A template was designed in an Excel file to provide basic information about the apps as well as specifying their main features and functionality characteristics. Some of these characteristics and functionality features were retrieved from the app's description available in the app repository.

3. Results and discussion

This section presents and discusses the results of this study. A total of 167 apps, 123 Android apps, and 44 iOS apps were identified as both free and highly rated apps.

3.1. General information about the apps

0.02wTables A.11–A.16 in Appendix present general information about the apps such as name, link, rating, number of raters, number of installations (not available for iOS apps), and date of latest update. The majority of the selected apps (68%) offer in-app purchases for paid features and functionality. These apps are free to download and use, but many of their proposed functionality features are not available without...
thoughts, which play a key role in symptoms of anxiety, and bring relaxation or a state of restful alertness. It helps to reduce worrying most common. It has also shown positive results in the prevention of anxiety and stress-induced changes like HR and BP [49]. A meta-analysis of controlled trials for the use of meditation for anxiety also reported a level of efficacy of meditative therapies in reducing anxiety symptoms [46]. Additionally, meditation has been shown to be effective in managing various types of anxiety such as panic disorder and agoraphobia [41].

Breathing exercises are another mechanism that can help to relax and relieve stress. While practicing deep breathing, a message is sent to the brain to calm down and relax. Biochemical changes subsequently decrease HR and BP and help the person to relax [47]. Studies have shown that breathing exercises can improve cognition and overall well-being [48], while also reducing anxiety [48–52]. Breathing exercises can also have a positive impact on psychological distress, quality of sleep [49], depression [50–52], everyday stress, PTSD, and stress-related medical illnesses [50,53]. Breathing exercises are also used to help with asthma, which was the case in A3 and A6. However, it should be noted that such exercises may help patients whose quality of life is impaired by asthma, but they are unlikely to reduce the need for anti-inflammatory medication [54].

Many of the selected apps provided educational content about anxiety and other mental issues, symptoms, and management methods, either in the form of courses, articles, videos, or others. Educating users about anxiety can help to reassure them and provide them with the necessary knowledge by answering questions and correcting misinformation that they might have. Educating users about the provided management method and its benefits may also increase their trust in the management approach and their willingness to try it. Mental assessment tests have been provided by some apps to give the user an idea about his/her mental status, anxiety, stress and/or depression levels.

Relaxing music and sounds is a noninvasive and free of side-effects approach that has been used in 31 apps as a management method. It has been shown to be an effective tool for the reduction of anxiety, stress, and depression [55,56]. It has also shown positive results in the prevention of anxiety and stress-induced changes like HR and BP [57]. Developers should take into account the type of music and sounds used.

Table 2 presents various management methods identified in the selected anxiety apps with meditation and breathing exercises being the most common.

The main goal of meditation is to help the user enter a deep state of relaxation or a state of restful alertness. It helps to reduce worrying thoughts, which play a key role in symptoms of anxiety, and bring about a feeling of balance, calmness, and focus [40]. Several studies have presented evidence supporting the use of meditation in anxiety treatments [41–43]. One study reported that it was beneficial for a group of Chinese nursing students in reducing anxiety symptoms and lowering systolic BP [44]. Another study reported that it showed improvements in the reduction of anxiety for breast cancer patients [45].

| Management method | App ID | Total |
|-------------------|--------|-------|
| Meditation        | A1, A8, A9, A10, A13, A16, A18-A21, A23, A25, A30, A33-A37, A40, A41, A44, A56, A59, A62, A66, A67, A70, A82, A86, A92, A98, A105, A106, A111, A121, I, I2, I6-I10, I11, I13, I16, I18, I23, I25, I29, I30, I32, I34, I40, I42 | 54 |
| Breathing exercises| A3, A6, A20, A21, A23, A25, A29, A30A34, A37, A41, A45, A47, A53-A55, A59, A70, A72, A73, A76, A80, A83, A92-A94, A96, A98, A10, A110, A111, A115, A119, A120 I2, I4, I8, I10, I11, I13, I16, I18, I23, I25, I29, I30 | 46 |
| Educational content| A1, A8, A12, A100, A103, A104, A113, A115, A119, A121, A22, A26, A33, A34, A40, A42-A44, A54, A57, A59, A61, A63, A70-A73, A76-A79, A86, A88, A90, I2, I6, I23, I30, I34 | 39 |
| Relaxing music and sounds | A4, A7, A11, A15, A16, A18, A30, A36, A42, A52, A59, A66, A68, A77, A79, A82, A87, A98, A99, A107, A109, I3, I8, I13, I16, I18, I25, I30, I32, I34 | 31 |
| Mood and symptom tracking, journaling, diaries and day planning | A14, A22, A24, A25, A34, A39, A41, A44, A48, A49, A59, A63, A66, A69, A70, A75, A76, A78, A88, A91, A97, A100, A103, A114, A119, A120, A122, I29I33I79 | 33 |
| Assessment tests | A117, A12, A33, A34, A48, A66, A69, A70, A72, A78, A79, A88, A91, A103, A113, I7 | 17 |
| Games | A31, A32, A43, A46, A51, A58, A60, A63, A65, A84, A96, A101, A112, A119, A120, I2, I4, I5, I7, I20-I22, I24, I27, I28, I31, I36-I39, I41, I43, I44 | 33 |
| Stories | A8, A18, A30, A36, A49, A59, A82, A98, A118, I8, I9, I18, I28, I30, I32, I34, I42 | 16 |
| Mindfulness practices | A10, A12, A20, A25, A56, A98, A111, A15, I2, I6, I7, I11, I19, I23, I29, I30 | 16 |
| Guided relaxation | A22, A23, A33, A34, A40, A42, A54, A103, A111, A115, I3, I6, I9, I9 | 14 |
| Community chats with app users via the app | A8, A25, A27, A50, A61, A63, A78, A85, A119, A123, I9 | 11 |
| Yoga and physical exercises | A1, A2, A5, A8, A28, A30, A47, A48, A55, A59, A77, A95, A102, A108, A116, A119, I11 | 17 |
| Motivational and inspirational statements | A16, A44, A47, A63, A72, A74, A76, A78, A81, I5, I26, I33 | 12 |
| Online therapy and coaching | A18, A26, A27, A34, A50, A89, A90, A92 I9, I35 | 10 |
| Recommending activities and tips | A42, A64, A66, A100, A102, A108, A113, A120, I19 | 9 |
| Interactive messaging | A17, A18, A48, A49 | 4 |
as well as the accompanying environment, as they both affect the effectiveness of this method [58,59].

Thirty-one apps provided journaling and writing diaries to help users plan their day, track their mood, and express their thoughts, feelings, and emotions. Securing the privacy and confidentiality of users’ information is critical in such apps. All selected iOS apps providing journaling provide authentication methods, while only 41% of Android apps with this functionality provide users with the same level of authentication.

Eleven apps provide the user with the possibility of communicating with other users. In these apps, users are able to share their experiences, talk about their issues, help each other, and relate to others who are undergoing similar problems as their own. In the current COVID-19 pandemic, being in a state of isolation but having the ability to connect with an online community can be very helpful. The idea of enabling interaction with a community of people with similar issues is quite interesting and can be extremely helpful, especially given that people with anxiety often tend to avoid direct communication [60]. For users who prefer communication with mental health care professionals, there are ten apps available that provide online therapy and coaching, enabling users to communicate with mental health care professionals, without having to travel, while also avoiding obstacles like stigma and distance. Selected apps offering online therapy services charge fees for these services. These apps also provide information on the mental health care professionals’ credentials. This information is important as it allows the user to check whether these professionals are appropriately accredited and decide which mental health care professional is most suited for his/her needs.

Thirty-three apps provide users with games like coloring books, puzzles, and slime simulations, as management methods for anxiety. These games help the user to relax, and to take his/her mind off worrying thoughts or feelings. Games are usually enjoyable and entertaining and this may motivate users to continue using these apps.

The variety of management methods identified in the selected apps points to the high potential of apps usage for coping with anxiety. Developers have integrated various promising and effective management methods in their apps’ functionality features. Users can access these features at any time and in any place. This could be beneficial for users with anxiety disorders, especially in situations where immediate help is needed (e.g., during panic attacks), or in cases where mental health care professional cannot be reached due to circumstances like distance or the current global lockdown situation.

### 3.2.2. Intervention approaches

Table 3 presents the selected apps which state the use of specific intervention approaches for anxiety management. The most used ones included mindfulness, cognitive behavioral therapy (CBT), and hypnosis.

Mindfulness was the most adopted management approach. It is defined as “bringing one’s complete attention to the present experience on a moment-to-moment basis” [61]. Mindfulness practices allow practitioners to shift their concentration to their internal experiences occurring in each moment, such as bodily sensations, thoughts, and emotions, or to their external environment consisting of sights and sounds [62,63]. There are a number of interventions that are based on mindfulness, like mindfulness-based stress reduction, mindful meditation, and mindfulness-based cognitive therapy. Many approaches incorporate mindfulness in their process such as Dialectical Behavioral therapy (DBT) and Acceptance Commitment Therapy (ACT) [64], which are used in some of the selected apps. Mindfulness can be delivered through guided relaxation tools like guided relaxation audios, videos, or text. Studies have reported that mindfulness has shown promising results for treating anxiety and mood problems [65,66], and improving an individual’s internal cognitive, emotional, and physical experience [67]. Some findings suggest that mindfulness can be more complicated than it might seem, as many elements like attention emotional balance, differences in emotion-responding variables, and clinical context can influence its effect [68-70]. Therefore, these elements should be taken into account while developing mindfulness-based anxiety apps.

CBT is a form of psychological treatment, mainly based on efforts to change thinking patterns [71]. Many studies have supported the effectiveness of CBT-based interventions for the treatment of anxiety, and have reported on the long-term positive effect it has on both children and adults [72,29]. A study examining available evidence on CBT have yielded positive results and confirmed its effectiveness for anxiety

### Table 3

| Intervention approach | App ID | Total |
|-----------------------|--------|-------|
| Mindfulness           | A8, A10, A12, A17, A20, A25, A29, A34, A40, A41, A48, A49, A56, A81, A86, A106, A111, A121, I2, I6, I7, I11, I18, I19, I23, I29, I30, I33, I42 | 29     |
| Cognitive behavioral therapy (CBT) | A17, A18, A22, A24, A33, A34, A40, A41, A44, A46, A48, A49, A58, A63, A70, A76, A78, A89, A97, A100, A101, A103, A115, I7, I33 | 25     |
| Hypnotherapy          | A21, A36, A67, A105, A118, A121, I2, I5, I30, I40 | 10     |
| Artificial intelligence (AI) | A17, A18, A49, A113, I29, I33 | 6      |
| Brainwaves and special beats and frequencies | A77, A105, A107, I2, I34 | 5      |
| Dialectical Behavioral therapy (DBT) | A18, A49, A76, A89, A100 | 5      |
| Autonomous Sensory Meridian Response (ASMR) | A30, I17, I21, I28, I39 | 5      |
| Acceptance Commitment Therapy (ACT) | A17, A40, A63, I7 | 4      |
| Spiritual and religious basis | A35, I2, I9 | 3      |
| Biofeedback           | A6, A113 | 2      |
| Positive Psychology   | A48, I33 | 2      |
| Behavioral Activation Therapy | A66 | 1      |
| Bilateral stimulation a part of Eye Movement Desensitization and Reprocessing therapy (EMDR) | A79 | 1      |
| Horoscope based       | A82 | 1      |
| Neuro-linguistic programming (NLP) | A111 | 1      |
| Tapping (EFT), combination of ancient Chinese acupuncture and modern psychology | A13 | 1      |
disorders [73]. CBT has also been used in the treatment of some specific anxiety disorders like PTSD [74] and OCD [75]. It has also been proved effective for depression, alcohol and drug use problems, eating disorders, and severe mental illness [71]. CBT and mindfulness-based therapy can also be useful in reducing anxiety during the COVID-19 pandemic [76].

Hypnosis is a therapeutic technique designed to bring relaxation and focus to the mind [77]. Many studies have reported the effectiveness of hypnosis for the treatment of anxiety. One study stated that it can reduce anxiety among palliative care patients with cancer [78], and another reported on its considerable benefits to terminally ill patients [79]. Hypnosis is also used to treat and manage stress and phobias [80], as well as sleep and physical symptoms [78].

Other approaches have also been identified in the selected apps as shown in Table 3, but it should be noted that a few of them were not based on scientific approaches.

3.2.3. Targeted mental health problems/symptoms

Table 4 presents the different health issues besides anxiety that were addressed by the selected apps. All selected apps addressed general mental health problems addressed by the selected apps.

Table 4

| Mental health problems addressed by the selected apps. | App ID | Total |
|--------------------------------------------------------|--------|-------|
| Stress                                                 | A1-A8, A10-A13, A16-A21, A24, A28-A30, A33-A38, A40, A41, A44, A48-A50, A52, A53, A56, A57, A59, A63-A65, A67-A69, A72, A77, A79-A88, A92, A95, A98-A100, A102, A103, A105, A106, A108-A113, A115, A116, A118, A121, II-13, I, 18-112, II-16-20, I-II-25, I27, I29-134, I36, I37, I39-143 | 107 |
| Sleep problems                                          | A2, A3, A6-A11, A13, A15, A16, A18-A21, A23, A30, A33, A35-A38, A44, A48, A52, A56, A59-67, A77-99, A82, A83, A86, A87, A90, A105, A109, A118, A121, II-12, I15, I7-110, I13, I16, I18, I23, I25, I29, I30, I32, I40, I42 | 59 |
| Depression                                              | A5, A11, A17, A18, A20, A27, A28, A33-A35, A38, A39, A41, A44, A45, A48-A50, A61, A63, A64, A66, A72, A75, A77, A78, A80, A83, A85, A87, A89, A90, A92, A95, A97-101, A103-105, A114, A120-A123, I7, I9, I11, I19, I26, I34, I35 | 54 |
| Panic and panic attacks                                 | A18, A22, A23, A40, A42, A54, A55, A69, A72, A73, A75, A80, A89, A94, A96, A97, A105, A106, A120, A122, I7 | 21 |
| Anger                                                   | A18, A29, A38, A48, A50, A63, A98, A105, I8, I34, I41 | 11 |
| Focus and concentration                                 | A6, A11, A20, A29, A38, A86, A112, I13, I18 | 10 |
| Self-esteem and confidence                              | A18, A20, A21, A83, A88, A118, A121, II, I2, I5, I8, I26 | 12 |
| Pain                                                    | A12, A13, A37, A49, A64, A83, A107, I18, I23 | 9 |
| Mood                                                    | A5, A14, A18, A39, A69, A77, A89, A95, A120 | 9 |
| OCD                                                     | A26, A31, A32, A46, A58, A78, A89, A105 | 8 |
| PTSD                                                    | A78, A80, A89, A97, A105, A123, I7 | 7 |
| Weight issues                                           | A6, A13, A21, A83, A121, I2, I30 | 7 |
| Addiction and alcohol use                               | A35, A49, A79, A90, A123, I2, I30 | 7 |
| Social anxiety disorder                                 | A69, A70, A71, A89, A117, I7 | 6 |
| Eating disorder                                         | A61, A78, A120, A123 | 4 |
| Suicide and self-harm                                   | A61, A78, A120 | 3 |
| Grief and loss                                          | A18, A49, A83 | 3 |
| Attention                                              | A6, A65, A83 | 3 |
| Phobia                                                  | A50, A70, I2 | 3 |
| Problems related to pregnancy                           | A13, A38 | 2 |
| Memory                                                  | A6, A65 | 2 |
| ADHD (Attention Deficit Hyperactivity Disorder)         | A107, I18 | 2 |
| Separation anxiety                                      | A71 | 1 |
| Performance anxiety                                     | A71 | 1 |

disorders [73]. CBT has also been used in the treatment of some specific anxiety disorders like PTSD [74] and OCD [75]. It has also been proved effective for depression, alcohol and drug use problems, eating disorders, and severe mental illness [71]. CBT and mindfulness-based therapy can also be useful in reducing anxiety during the COVID-19 pandemic [76].

Hypnosis is a therapeutic technique designed to bring relaxation and focus to the mind [77]. Many studies have reported the effectiveness of hypnosis for the treatment of anxiety. One study stated that it can reduce anxiety among palliative care patients with cancer [78], and another reported on its considerable benefits to terminally ill patients [79]. Hypnosis is also used to treat and manage stress and phobias [80], as well as sleep and physical symptoms [78].

Other approaches have also been identified in the selected apps as shown in Table 3, but it should be noted that a few of them were not based on scientific approaches.

3.2.3. Targeted mental health problems/symptoms

Table 4 presents the different health issues besides anxiety that were addressed by the selected apps. All selected apps addressed general

Table 5

| Mental health care professional involved | ID |
|----------------------------------------|----|
| Experts including Tara Brach, Ph.D (psychologist); Mark Williams (Emeritus professor of clinical psychology); and Richard Alpert (psychologist) | A8 |
| Project team of PhDs and experts including Jason Owen (clinical health psychologist) | A12 |
| Team of doctors led by Dr. Jose Hamilton (psychiatrist and member of the American Psychiatric Association) | A17, I7 |
| Glenn Harrold (hypnotherapist and self-help author) | A21, I2 |
| Licensed mental health professionals at Duke university | A24 |
| Judson Brewer, MD, PhD (psychiatrist, neuroscientist and author) | A25 |
| Silja Livin (clinical psychologist) | A43 |
| Dr. Guy Doron (clinical psychologist and researcher) | A46, A58, A101 |
| Dr. Alison Darcy (psychologist); and Dr. Athena Robinson (psychologist) | A49 |
| Mark Bowden (hypnotherapist) | A121 |
| Expert including Elisha Goldstein (psychologist); Michael Apollo (registered psychotherapist and corporate consultant); Ashley Turner (marriage and family therapist and yoga instructor), Roger Nolan (mindfulness-based psychotherapist) | I25 |
| Therapists | A18, A26, A50, A89, A92, I35 |
| Counselors and Coaches | A27, A90 |
| Psychologists | A34, A119 |
| Hypnosis experts | A36, A105 |
| Psychiatrists and therapists | A48, I19 |
| Multiple mental health care professionals | A66 |
| Clinician | A76 |
anxiety. Some apps addressed specific types of anxiety like social anxiety, separation anxiety, performance anxiety, OCD, PTSD, and panic attacks.

Some apps addressed other mental and physical issues, which usually occur with anxiety like stress [80,53], sleep issues [78], and depression [71,41,53]. Some apps used management methods to treat addiction-related issues, eating disorders [71], phobias, [80], and asthma [54].

3.2.4. Physical health information used by apps
The majority of the apps do not use physical health information. HR and BP are impacted by anxiety and stress [57]. Both can be used by apps to indicate the anxiety level of the user [20]. Yet in our selection only two apps provided this functionality feature (A6 and A113). A113 collects data on HR variability, using the photoplethysmogram (PPG) technique to get insights on the user’s health, including stress, energy, and productivity levels. The app also allows the user to manually enter BP as a convenient way of journaling. It should be noted that A6 provides cardiovascular tests, including HR and peripheral blood circulation, as an app purchase option.

3.2.5. Involvement of mental health care professionals
Only 19% of the selected apps reported involvement of mental health care professionals as presented in Table 5. Apps providing online therapy specified information about the therapists that the user can contact. This information includes their specialty, experience, and diplomas. Some apps shown in Table 5 provided names of the professionals involved in their co-creation. Providing names gives the user the possibility to look online for the credentials of the involved professionals and might increase the user’s trust toward these apps. We cross-checked the names displayed in Table 5 and found them to be legitimate. Table 5 also shows apps that mention the involvement of mental healthcare professionals in their content creation without providing their names. Involvement of mental healthcare professionals in the apps, varied between involvement in the co-creation of the app, production of the content of the app, and in providing online therapy and care. For mental healthcare professionals cited to be involved in the co-creation, their input in the process cannot be exactly specified.

Some apps involved professionals experienced in certain well-being fields, but did not have a mental health background. A1 involved Sadhguru (an Indian yogi, mystic, and author) who was also involved in A8; A23 was based on a book by Barry McDonagh (an author and creator of the Panic Away Program); A30 involved sleep professionals and experts; A56 involved meditation teachers; A74 involved Steve Maraboli (a motivational speaker and author); A108 was developed by a student counseling service; A111 involved Sanna Wikstrom (a Neuro-linguistic programming master practitioner); I6 involved Sam Harris (an author and a neuroscientist) who was also involved in A8; I34 involved spiritual teachers and healers; and I42 involved meditation experts.

It should be noted that many management methods and/or approaches might not be used correctly or efficiently if they are not under the supervision or approval of specialists, especially in the case of mental health. Including mental health care professionals in the co-creation of anxiety apps is critical for the correct use of psychological management methods.

3.3. Other functionality
3.3.1. Authentication method
Table 6 presents the authentication methods identified in the selected apps. The majority of the selected apps (66%) do not require authentication. The absence of authentication might give the user a sense of anonymity. However, authentication can help the user ensure the privacy of his/her data. The app A97 requests a nickname and a password, ensuring security and confidentiality as well as keeping the anonymity of the user, since it does not use any information or sources that could reveal the identity of the user like Facebook account, google account, or email.

3.3.2. Gamification features
Gamification is the use of game elements in non-gaming systems which are mainly used to improve user experience and user engagement [81]. Table 7 presents the different gamification methods identified in the selected apps. Note that some apps use more than one gamification method. The majority of the selected apps used gamification features to

### Table 6
| Authentication method | App ID | Total |
|-----------------------|--------|-------|
| No authentication required | A1, A3-A7, A9-A12, A14, A15, A18, A19, A21, A22, A24, A27-A29, A31-A33, A37-A39, A42, A43, A45, A46, A50-A53, A55, A57, A58, A60, A62, A65, A66, A68-A81, A83, A84, A87, A91, A93-A96, A98-A112, A114-A117, A120, A122, I15, I8, I10, I12, I14-I17, I21, I22, I24, I25, I27, I28, I31, I36-I39, I41-I44 | 111 |
| Email | A2, A8, A13, A16, A17, A20, A23, A25, A26, A24, A36, A40, A41, A44, A48, A49, A54, A56, A59, A61, A63, A64, A67, A82, A86, A88-A90, I92, I113, I118, I119, I121, I123, I16, I17, I19, I11, I13, I18, I19, I23, I26, I29, I30, I32-I35, I40 | 51 |
| Facebook | A2, A8, A13, A16, A23, A30, A33, A34, A40, A44, A48, A56, A59, A61, A64, A82, A85, A86, A88, A89, A92, I113, I118, I123, I13, I18, I20, I23, I29, I30, I34, I35 | 32 |
| Google account | A2, A13, A16, A23, A30, A34, A44, A47, A48, A56, A61, A85, A86, A88, A89, I92, A113, A123, I20, I29, I35 | 22 |
| Twitter | A86 | 1 |
| Nickname and password | A97 | 1 |

### Table 7
| Gamification features | App ID | Total |
|-----------------------|--------|-------|
| Game | A31, A32, A43, A46, A51, A58, A60, A63, A65, A72, A84, A96, A101, A112, A119, A120, I14, I15, I17, I20-I22, I24, I27, I28, I31, I36-I39, I41, I43, I44 | 33 |
| Graphics | A3, A6, A29, A30, A37, A41, A55, A59, A70, A73, A76, A80, A83, A93, A94, A98, A115, A120, I116, I14 | 20 |
| Goals and achievements | A12, A14, A25, A36, A41, A47, A48, A54, A55, A56, A64, A76, A88, A100 | 14 |
| Levels, steps and progress | A10, A34, A37, A56, A61, A91, A113, I19, I42, I9 | 10 |
| Challenges | A10, A16, A22, A23, A34, A35, A56, A70, I30 | 9 |
| Unlocking new features | A14, A17, I18, I33, I7 | 5 |
| Score and points | A27, A48, A54, I8 | 4 |
| Stickers, awards and stars | A14, A16, A20, A100, I11 | 5 |
encourage and motivate the user. Creating a fun, interactive user experience with the adoption of game elements can create an enjoyable user experience, which can further reduce boredom and motivate users keep using the app. This can also increase user engagement, leading to users providing more accurate information about their mental health status and to increased benefit for the user from the provided mental health care management method.

Gamification is a widely used approach that has shown effectiveness with anxiety and other mental health problems, such as depression and PTSD for military personnel [82,83], and aggression for veterans [84]. Combining game elements and knowledge on game players’ behaviors with known mental health care management methods is an interesting approach that can result in the creation of effective anxiety apps.

3.3.4. Languages

Table 9 presents the languages available in the selected apps. The majority of the apps (127 app) are available only in English, which can be explained by the fact that the search string applied in app repositories was in English. Only one app (A98) automatically translates its content to the device's preferred language. While the rest of the apps are available in more than one language. Availability in multiple languages can help reach a larger number of users.

Table 8 presents the different social features provided by the selected apps. Many apps provide social and communication features, which allow the user to connect with communities of app users as well as with centers and associations, or with others to share content and progress. Those social features could prove to be beneficial to the user. For instance, sharing progress and content from the app via social networks (SN) and emails helps provide social support to the user from family and friends. Social support is significantly associated with wellbeing and absence of psychological distress [85]. It has a favorable effect on certain psychological issues [86], and can serve as a mediator to stress and anxiety caused by life events [87]. Providing social support is also among the behavioral change techniques implemented in m-health apps to promote app usage [88]. Additionally, providing contacts in case of emergencies is crucial and might help the user in critical situations where he/she feels the need for immediate help. Links to associations, websites, and centers can provide the user with more helpful resources. Social features are very important as they help the user connect with others in a beneficial way.

Table 9 presents the languages available in the selected apps. The majority of the apps (127 app) are available only in English, which can be explained by the fact that the search string applied in app repositories was in English. Only one app (A98) automatically translates its content to the device's preferred language. While the rest of the apps are available in more than one language. Availability in multiple languages can help reach a larger number of users.

3.4. Offline availability

Table 10 shows whether an app requires internet access to function or not. Internet access is required to install and create accounts for all apps, but once that is done, many apps function without internet access.

Offline availability is an aspect that will help users benefit from the app without necessarily being in a setting with internet access. This will decrease the app’s limitations and make it more accessible to users. However, some of the management methods identified do require internet access, like online therapy and communication with communities of app users. Additionally, offline availability may require downloading more data that could be permanently stored, which may affect a phone’s memory and performance. Some apps were only partially available offline, resulting in limited functionality when internet access was not available. Other apps only made downloaded data available offline, meaning the user chooses and downloads content that he/she wants to be available while offline. These are convenient solutions to offline availability that do not compromise on app functionality.

3.5. Limitations

This study is subject to limitations, such as: (i) missing terms (e.g., stress, depression) in the search string that might have resulted in the selection of relevant apps, as usually an app targets more than one mental health issue. However, the search string used identified any app that mentions anxiety in its title and/or description, therefore this can alleviate the threat of missing relevant apps; and (ii) the first author conducted the search and applied the EC and IC to the initial selection. However, the final selection has been reviewed by the second author.

4. Conclusion and future work

With the current development in mobile communication and the wide ownership of mobile devices, m-mental health seems to be one of the most promising ways to deliver care to people in need regardless of their situation. Under certain circumstances like the current COVID-19 pandemic, the use of mobile communication and apps for anxiety might become a necessity. Panic attacks can mimic COVID-19 symptoms, which might worsen the condition of people with anxiety disorders [89]. Having an app on hand that can ease anxiety in such circumstances is useful.

This study highlights the functionality and characteristics of anxiety apps that are well rated by users. We plan to build on the reported
findings to develop a reusable requirements catalog for anxiety apps. Mental health care professionals and people with anxiety disorders will be involved in the co-creation of this catalog. The catalog will also include software quality requirements based on the ISO/IEC 25020 standard and recommendations from the UK National Health Service (NHS) and the Health Insurance Portability and Accountability Act (HIPAA) on health apps. Since the reusable requirements catalog for anxiety apps will be based on functionality of existing highly rated apps, as well-being based on inputs from mental health care professionals and people suffering from anxiety, it could be used to assist developers to select relevant requirements for anxiety apps. Apps could therefore be designed based on the catalog to assist people dealing with anxiety. Requirements from the catalog could also be used to generate checklists for audit and evaluation purposes [90], either to evaluate apps or to compare their functionality and characteristics.

The findings from this study may also assist researchers and developers interested in the field of m-mental health, especially in the sub-field of anxiety, to have an overview of the characteristics and functionality of existing highly rated apps for anxiety. Our findings could also assist mental health professionals to find anxiety apps that could be integrated in their mental health care process, as well as assist people suffering from anxiety to find mobile apps best suited for their needs. During the COVID-19 pandemic, m-health can also help disseminate health information among health personnel and community workers [91].

Summary points

What was already known on the topic:

– Anxiety disorders are a common mental issue.
– There are many barriers to mental health care delivery, mainly cost, stigma and distance from health professionals.
– Apps were found to be effective tools to deliver mental health care, and overcome the aforementioned barriers.

What this study added to our knowledge:

– 167 free and high-rated anxiety apps were analysed: 123 Android apps, and 44 iOS apps.

– Anxiety apps addressed other health issues, such as stress, depression, sleep issues, and eating disorders.

– Anxiety apps adopted various management, treatment and coping approaches such as, meditation, breathing exercises, mindfulness and cognitive behavioral therapy.

– Results showed that 51% of the selected apps use various gamification features to motivate users to keep using the apps; 32% provide social features including chat, communication with others and links to sources of help; 46% are available offline and 67% are available only in English; only 19% reported involvement of mental health professionals in their design; 68% offer in-app purchases to unlock features and functionality; and 64% updated their functionality and content in the three first months of 2020, which can be linked to COVID-19 outbreak.

Compliance with ethical standards

This article does not contain any studies with human participants or animals.

Author contributions

All authors contributed to the creation of the manuscript. ND: design, conception, acquisition and interpretation of data, classification of selected apps, drafting of the manuscript, revision. SO: design, conception, statistical support, interpretation of data, drafting of the manuscript, critical revision. MAJI and MG: critical revision. All authors read and approved this manuscript.

Funding

This work is part of the Abu Dhabi Young Investigator Award (AYIA) 2019 (#AYIA19-001) awarded by the Abu Dhabi Research and Development Authority (ADRSA) and the Startup project (#3IT131) funded by the United Arab Emirates University.

Conflict of interest

The authors have no conflict of interest.
## Appendix A. Selection results

### Tables A.11–A.16

Table A.11
Selected Android apps. Part 1.

| ID | App's name | App's link | # Installs | Rating | # Raters | Update       |
|----|------------|------------|------------|--------|----------|--------------|
| A1 | Sadhguru – Yoga, Meditation & Spirituality | http://bit.ly/2Q4RFN6 | 1,000,000 | 4.9    | 22,641   | 20-Feb-20    |
| A2 | Yoga for Beginners | Down Dog | http://bit.ly/2p2NhUf | 500,000 | 4.9    | 10,261     | 07-Jan-20    |
| A3 | Breath Ball: The Stress Relief Breathing Exercise | http://rb.gy/R9f6yl | 50,000   | 4.9    | 1046     | 20-Mar-20    |
| A4 | Stress Buster- Relief from Stress and Anxiety | http://rb.gy/zh652n | 500      | 4.9    | 29       | 26-Dec-19    |
| A5 | 10 daily Stress Relief Yoga and Exercise | http://rb.gy/edcm4 | 1000     | 4.9    | 21       | 20-Dec-18    |
| A6 | Prana Breath: Calm &Meditate | http://bit.ly/2qXcM3 | 1,000,000 | 4.8    | 52,428   | 28-Dec-19    |
| A7 | Atmosphere: Relaxing Sounds – Rain &Sleep sounds | http://bit.ly/2cVb7z | 1,000,000 | 4.8    | 51,782   | 17-Feb-20    |
| A8 | Insight Timer – Meditation | http://bit.ly/2qCTvqj | 1,000,000 | 4.8    | 50,351   | 01-Nov-19    |
| A9 | Let’s Meditate: Guided Meditation | http://bit.ly/zhbMtd | 1,000,000 | 4.8    | 45,530   | 18-Aug-19    |
| A10 | Serenity: Guided Meditation & Mindfulness | http://bit.ly/2Q2Phqj | 100,000  | 4.8    | 6281     | 11-Feb-20    |
| A11 | Relaxing Sounds | http://bit.ly/2GxJ27I | 100,000  | 4.8    | 4865     | 02-Nov-19    |
| A12 | Mindfulness Coach | http://bit.ly/35zyi8H | 100,000  | 4.8    | 3190     | 25-Sep-19    |
| A13 | The Tapping Solution | http://rb.gy/99knhb | 100,000  | 4.8    | 1445     | 11-Mar-20    |
| A14 | Daylio – Diary, Journal, Mood Tracker | http://bit.ly/34NkKU | 500,000  | 4.7    | 284,742  | 25-Mar-20    |
| A15 | Sleep: Relaxing sounds, Sleep | http://bit.ly/2tmBolz | 1,000,000 | 4.7    | 66,240   | 17-Feb-20    |
| A16 | Meditopia: Meditation, Anxiété | http://bit.ly/34MMHq | 1,000,000 | 4.7    | 56,175   | 20-Feb-20    |
| A17 | Yupper – Emotional Health | http://bit.ly/32AAnRq | 1,000,000 | 4.7    | 46,031   | 15-Feb-20    |
| A18 | Wysa: stress, depression & anxiety therapy chatbot | http://bit.ly/2Q3NAs | 1,000,000 | 4.7    | 36,225   | 21-Feb-20    |
| A19 | Meditation&Relaxation: Guided Meditation | http://bit.ly/299Jsw | 1,000,000 | 4.7    | 35,822   | 16-Oct-18    |
| A20 | Stop, Breathe &Think: Meditation &Mindfulness | http://bit.ly/2X0XYZ | 1,000,000 | 4.7    | 17,355   | 18- Dec-19   |
| A21 | Relax &Sleep Well: Hypnosis and Meditation | http://bit.ly/33yFa0l | 500,000  | 4.7    | 6322     | 06-Nov-19    |
| A22 | Stop Panic &Anxiety Self-Help | http://bit.ly/2K5YaX | 100,000  | 4.7    | 2353     | 19-Aug-16    |
| A23 | Dare – Break Free From Anxiety | http://bit.ly/36OhnL | 100,000  | 4.7    | 2191     | 20-Feb-20    |
| A24 | CBT Thought Record Diary | http://bit.ly/2nyGIxI | 100,000  | 4.7    | 671      | 24-Jan-20    |
| A25 | Unwinding Anxiety* | http://rb.gy/qhtmdv | 10,000   | 4.7    | 237      | 18-Oct-19    |
| A26 | NOCD: OCD Treatment App | http://rb.gy/ylhrom | 10,000   | 4.7    | 263      | 20-Mar-20    |
| A27 | Help – Depression, Anxiety, Relief, Social Texting | http://rb.gy/yysp | 50,000   | 4.7    | 2084     | 29-Jan-20    |
| A28 | Stress Relief Yoga and Exercise Fitness App | http://rb.gy/lhpdcp | 1000     | 4.7    | 17       | 22-Aug-19    |
| A29 | Breathing Exercise App: Breath – Just Breathe | http://rb.gy/prvagt | 1000     | 4.7    | 67       | 05-Nov-18    |
| A30 | Relax Melodies: Sleep Sounds | http://bit.ly/2NmzIJa | 10,000,000 | 4.6    | 281,389  | 07-Feb-20    |
| A31 | Energy: Anti Stress Loops | http://bit.ly/36PtmU | 5,000,000 | 4.6    | 249,874  | 18-Feb-20    |
| A32 | Harmony: Relaxing Melodies | http://bit.ly/2ux9jpm | 1,000,000 | 4.6    | 27,168   | 28-Jan-20    |
| A33 | Moodpath – Depression & Anxiety Test | http://bit.ly/2m5FtC | 1,000,000 | 4.6    | 23,980   | 14-Feb-20    |
| A34 | Sanvello (ex Pacifica) | http://bit.ly/2rmFG | 1,000,000 | 4.6    | 14,106   | 18-Feb-20    |
| A35 | Abide: Christian Guided Meditation &Daily Prayers | http://bit.ly/200pnkt | 500,000  | 4.6    | 17,548   | 19-Feb-20    |
| ID  | App's name                                                                 | App's link                                                                 | # Installs | Rating | # Raters | Update       |
|-----|-----------------------------------------------------------------------------|-----------------------------------------------------------------------------|------------|--------|----------|--------------|
| A36 | Deep Meditate – Meditation, Relaxation, Sleep App                           | [http://bit.ly/2K5WWjP](http://bit.ly/2K5WWjP)                              | 500,000    | 4.6    | 8358     | 09-Feb-20    |
| A37 | Relax Lite: Stress Relief                                                   | [http://bit.ly/2NyGoCM](http://bit.ly/2NyGoCM)                              | 500,000    | 4.6    | 3342     | 28-Jul-16    |
| A38 | Music for Meditation                                                        | [http://bit.ly/2K7gyx9F](http://bit.ly/2K7gyx9F)                            | 100,000    | 4.6    | 4034     | 02-Jan-20    |
| A39 | eMoods Bipolar Mood Tracker                                                 | [http://bit.ly/2qJxQ56](http://bit.ly/2qJxQ56)                              | 100,000    | 4.6    | 4009     | 28-Oct-19    |
| A40 | Pocketcoach – Anxiety Helper                                                | [http://rb.gy/dmh10](http://rb.gy/dmh10)                                   | 5000       | 4.6    | 63       | 17-Mar-20    |
| A41 | Moodfit – Tools & Insight to Shape Up Your Mood                              | [http://rb.gy/gce1k5](http://rb.gy/gce1k5)                                 | 10,000     | 4.6    | 280      | 20-Mar-20    |
| A42 | Panic Attacks?                                                               | [http://rb.gy/nmjqp5](http://rb.gy/nmjqp5)                                 | 10,000     | 4.6    | 257      | 23-Apr-14    |
| A43 | eQuos: Emotional Fitness Game                                                | [http://rb.gy/wmij4ah](http://rb.gy/wmij4ah)                               | 10,000     | 4.6    | 1811     | 18-Dec-19    |
| A44 | feel better – Mood & CBT therapy to manifest goals                          | [http://rb.gy/wyq73](http://rb.gy/wyq73)                                   | 50,000     | 4.6    | 539      | 11-Mar-20    |
| A45 | Care Depression & Anxiety with Breath                                       | [http://rb.gy/yj1xy0](http://rb.gy/yj1xy0)                                 | 100        | 4.6    | 45       | 25-Sep-18    |
| A46 | GG Relationship Doubt & Obsessions (ROCD)                                   | [http://rb.gy/3iuex](http://rb.gy/3iuex)                                   | 10,000     | 4.5    | 163      | 01-May-19    |
| A47 | Fabulous! Coach Lifestyle, Meditation & relaxation                          | [http://bit.ly/34OCxH](http://bit.ly/34OCxH)                               | 5,000,000  | 4.5    | 292,099  | 08-Feb-20    |
| A48 | InnerHour: Calm, Sleep, Depression & Anxiety Therapy                        | [http://bit.ly/2pNIO8n](http://bit.ly/2pNIO8n)                             | 500,000    | 4.5    | 4109     | 11-Feb-20    |
| A49 | Woebot: Your Self-Care Expert                                               | [http://bit.ly/33y5I1g](http://bit.ly/33y5I1g)                             | 100,000    | 4.5    | 6223     | 15-Jan-20    |
| A50 | Online therapy – mental help. Support groups.                               | [http://bit.ly/36Pp82g](http://bit.ly/36Pp82g)                             | 100,000    | 4.5    | 3561     | 20-Feb-20    |
| A51 | #SelfCare                                                                   | [http://bit.ly/2pWi8Bi](http://bit.ly/2pWi8Bi)                             | 100,000    | 4.5    | 2057     | 29-Jul-19    |
| A52 | Deep Calm – Meditate, Sleep, Relax                                          | [http://bit.ly/33yt03F](http://bit.ly/33yt03F)                             | 100,000    | 4.5    | 1712     | 18-Sep-19    |
| A53 | Kardia Respiration Relaxation                                               | [http://bit.ly/3ZBwevW](http://bit.ly/3ZBwevW)                             | 100,000    | 4.5    | 1248     | 08-Nov-19    |
| A54 | Roend – Panic Attack & Anxiety Relief                                       | [http://bit.ly/2u548g](http://bit.ly/2u548g)                               | 100,000    | 4.5    | 800      | 08-Feb-20    |
| A55 | PanicShield – Panic Attack Aid                                              | [http://rb.gy/omstc7](http://rb.gy/omstc7)                                | 10,000     | 4.5    | 124      | 05-Apr-18    |
| A56 | Brightmind – Meditation for Stress & Anxiety                                | [http://rb.gy/lnjmm](http://rb.gy/lnjmm)                                  | 1000       | 4.5    | 54       | 04-Dec-19    |
| A57 | Stress Management – Effectively Reduce Stress                               | [http://rb.gy/jprax](http://rb.gy/jprax)                                  | 10,000     | 4.5    | 12       | 15-Jan-20    |
| A58 | OCD Daily Exercise by GG (GGOCC)                                            | [http://rb.gy/cig17](http://rb.gy/cig17)                                  | 10,000     | 4.5    | 153      | 28-Aug-19    |
| A59 | Calm – Meditate, Sleep, Relax                                                | [http://bit.ly/2K9jgcq](http://bit.ly/2K9jgcq)                             | 10,000,000 | 4.4    | 196,515  | 07-Feb-20    |
| A60 | My Oasis – Top Sky Island                                                    | [http://bit.ly/2CaP4A8](http://bit.ly/2CaP4A8)                            | 5,000,000  | 4.4    | 155,749  | 21-Feb-20    |
| A61 | TalkLife – Lonely, Stressed or Battling Anxiety?                             | [http://bit.ly/2K9ji3Q](http://bit.ly/2K9ji3Q)                            | 500,000    | 4.4    | 25,333   | 17-Feb-20    |
| A62 | Meditation Game                                                              | [http://bit.ly/36NqOes](http://bit.ly/36NqOes)                             | 500,000    | 4.4    | 4444     | 02-Apr-18    |
| A63 | What's Up? – A Mental Health App                                             | [http://bit.ly/2Q2HwJw](http://bit.ly/2Q2HwJw)                            | 500,000    | 4.4    | 3126     | 02-Jun-19    |
| A64 | SuperBetter                                                                 | [http://bit.ly/2Q08hB](http://bit.ly/2Q08hB)                              | 100,000    | 4.4    | 5838     | 05-Oct-18    |
| A65 | SRCH! Brain training & anti stress coloring games                           | [http://bit.ly/33zmn6](http://bit.ly/33zmn6)                              | 100,000    | 4.4    | 5156     | 10-Feb-20    |
| A66 | MoodTools – Depression Aid                                                  | [http://bit.ly/2K644wv](http://bit.ly/2K644wv)                            | 100,000    | 4.4    | 3057     | 07-Sep-19    |
| A67 | Harmony – Hypnosis Meditation                                                | [http://bit.ly/368S1a](http://bit.ly/368S1a)                              | 100,000    | 4.4    | 2946     | 05-Dec-19    |
| A68 | Relating Music for Stress – Anxiety Relief & Sleep                          | [http://bit.ly/2Q2ybf](http://bit.ly/2Q2ybf)                              | 100,000    | 4.4    | 715      | 13-Jan-20    |
| A69 | Anxiety Tracker – Stress and Anxiety Log                                    | [http://rb.gy/mik3xa](http://rb.gy/mik3xa)                                | 10,000     | 4.4    | 167      | 17-Mar-20    |
| ID  | App's name                                              | App's link                     | # Installs | Rating | # Raters | Update      |
|-----|---------------------------------------------------------|--------------------------------|------------|--------|----------|-------------|
| A70 | FearTools – Anxiety Aid                                | http://rb.gy/vols56           | 50,000     | 4.4    | 96       | 22-Sep-19   |
| A71 | Anxiety Symptoms + Treatment                           | http://rb.gy/vkhhyv           | 10,000     | 4.4    | 93       | 10-Jan-15   |
| A72 | Anxiety Cures – Relieve Stress, Increase Happiness    | http://rb.gy/rsefn            | 10,000     | 4.4    | 83       | 16-Jul-18   |
| A73 | Breathing exercises                                    | http://rb.gy/t5f6ek           | 50,000     | 4.4    | 293      | 05-Aug-17   |
| A74 | Anxiety Quotes                                        | http://rb.gy/dau7emd          | 1000       | 4.4    | 10       | 04-May-19   |
| A75 | Mood Log                                               | http://rb.gy/ik9rlkx          | 50,000     | 4.4    | 1156     | 02-Dec-19   |
| A76 | Clear Fear                                            | http://rb.gy/rcpxphl          | 100,000    | 4.4    | 173      | 07-Feb-20   |
| A77 | Fight Depression Naturally                             | http://rb.gy/vqgmtp           | 50,000     | 4.4    | 366      | 27-Jan-20   |
| A78 | Psychiatry Pro-Diagnosis, Info,Treatment,CBT &DBT      | http://rb.gy/ribnet           | 10,000     | 4.4    | 185      | 19-Mar-19   |
| A79 | Sleep Restore                                         | http://rb.gy/wjhtkki          | 5000       | 4.4    | 31       | 19-Apr-19   |
| A80 | Breathe Easy                                          | http://rb.gy/k6phb4           | 10,000     | 4.4    | 202      | 23-Jun-16   |
| A81 | TOBEE mindfulness coach                               | http://rb.gy/pagqvy           | 100,000    | 4.4    | 2943     | 18-Jul-18   |
| A82 | Mindrise: Sleep, Meditation, Music &Astrology         | http://rb.gy/vsjdoq           | 10,000     | 4.4    | 391      | 21-Mar-20   |
| A83 | Breathing Exercises                                    | http://rb.gy/19wvqa           | 10,000     | 4.4    | 231      | 03-May-19   |
| A85 | Friend Shoulder: Advices and Vent Anonymous – chat    | http://bit.ly/34Qp7LD         | 1,000,000  | 4.3    | 26,466   | 14-Feb-20   |
| A86 | The Mindfulness App: relax, calm, focus and sleep     | http://bit.ly/2plLWkN         | 1,000,000  | 4.3    | 10,828   | 31-Jan-20   |
| A87 | Relaxing Anti-Stress Sound                            | http://bit.ly/2XI17kl         | 1,000,000  | 4.3    | 10,006   | 1-Oct-17    |
| A88 | Remente: Self Improvement                             | http://bit.ly/36Uyj9D         | 500,000    | 4.3    | 9013     | 19-Feb-20   |
| A89 | BetterHelp: Online Counseling &Therapy                | http://bit.ly/32zvU2A         | 500,000    | 4.3    | 7392     | 12-Feb-20   |
| A90 | rTribe – Coaching for Anxiety/Addiction/Depression    | http://bit.ly/2GuUC23         | 100,000    | 4.3    | 3705     | 18-Feb-20   |
| A91 | Booster Buddy                                         | http://bit.ly/3ht0PoR         | 100,000    | 4.3    | 1445     | 10-Sep-19   |
| A92 | Online Therapy, Emotional diary, Mindfulness tools    | http://bit.ly/2Wz8kvw         | 100,000    | 4.3    | 1120     | 12-Feb-20   |
| A93 | Breathing Relaxation Exercises                         | http://bit.ly/2NuzA0W         | 10,000,000 | 4.3    | 119,257  | 13-Feb-20   |
| A94 | Panic Attack Anxiety Relief: Breathing Exercises     | http://rb.gy/mertgr           | 10,000     | 4.3    | 116      | 23-Jul-18   |
| A95 | Yoga for Relief of Anxiety, Stress and Depression    | http://rb.gy/sbhmom           | 10,000     | 4.3    | 82       | 12-Sep-18   |
| A96 | Flowy Beta                                            | http://rb.gy/ezt5tm           | 10,000     | 4.3    | 443      | 01-Dec-15   |
| A97 | UPI – Mood Tracker for Burnout and Bipolar            | http://rb.gy/2Jbdw9           | 50,000     | 4.3    | 1859     | 30-Jul-19   |
| A98 | Peace: Calm, Sleep, Meditation                        | http://rb.gy/jznj2            | 50,000     | 4.3    | 162      | 19-Jan-20   |
| A99 | Depression Relief &Treatment – Music Helper           | http://rb.gy/ugjfxv           | 10,000     | 4.3    | 247      | 13-Jan-20   |
| A100| De-StressMe: CBT Tools to Manage Stress               | http://rb.gy/bfl2eu           | 5000       | 4.3    | 42       | 14-Oct-19   |
| A101| Self-manage Depression: Daily exercise (GGDE)         | http://rb.gy/vvw47u           | 1000       | 4.3    | 33       | 15-Sep-19   |
| A102| Yoga For Stress Relief                                | http://rb.gy/og3th1           | 10,000     | 4.3    | 62       | 09-Jan-19   |
| A103| Depression CBT Self-Help Guide                        | http://bit.ly/36Olvh          | 100,000    | 4.2    | 1446     | 03-Nov-16   |
| A104| Dealing with Depression                               | http://rb.gy/3martk          | 1000       | 4.6    | 90       | 16-Jan-20   |
### Table A.14
Selected Android apps. Part 4.

| ID  | App's name                                           | App's link                     | # Installs | Rating | # Raters | Update   |
|-----|------------------------------------------------------|--------------------------------|------------|--------|----------|----------|
| A105| Anxiety Relief – Stress, Panic Attacks               | [link](http://bit.ly/32yWvVF)  | 100,000    | 4.2    | 1302     | 3-Jul-19 |
| A106| Mindfulness: Guided Meditation for Stress, Anxiety   | [link](http://bit.ly/2rw5IXp)  | 100,000    | 4.2    | 605      | 20-Jul-17|
| A107| Healing Sounds-Anxiety Relief                        | [link](http://rb.gy/wxzar)    | 50,000     | 4.2    | 279      | 05-Jun-14|
| A108| Exam Stress                                          | [link](http://rb.gy/gps6bj)    | 1000       | 4.2    | 10       | 18-Sep-17|
| A109| Relaxing Music for Sleep and Anxiety Relief          | [link](http://rb.gy/ru47je)    | 10,000     | 4.2    | 49       | 15-Mar-20|
| A110| Calm Meditation Stress Relief Breathing Exercises    | [link](http://rb.gy/mzbymd)    | 10,000     | 4.2    | 174      | 23-Jul-18|
| A111| Stress Less Cards                                    | [link](http://rb.gy/miz5hi)    | 10,000     | 4.2    | 39       | 11-Jun-17|
| A112| Balloon Pop – Balloon Game                           | [link](http://rb.gy/tj29p)     | 10,000     | 4.2    | 19       | 31-May-17|
| A113| WellTory: EKG Heart Rate                             | [link](http://bit.ly/2qfHbgc)  | 500,000    | 4.1    | 7320     | 21-Jan-20|
| A114| Monitor and Stress Relief                            | [link](http://bit.ly/2CaE3ml)  | 500,000    | 4.1    | 4182     | 21-Feb-20|
| A115| Stress &Anxiety Companion                            | [link](http://rb.gy/ewjxuf)    | 10,000     | 4.1    | 14       | 20-Feb-20|
| A116| Yoga for Anxiety                                     | [link](http://rb.gy/mnmoj)     | 10,000     | 4.1    | 160      | 27-Sep-18|
| A117| Social Anxiety Test                                  | [link](http://rb.gy/u2zfm)     | 10,000     | 4.1    | 38       | 03-Apr-18|
| A118| Elaine Martin Kids Hypnosis                          | [link](http://rb.gy/2221f)     | 1000       | 4.1    | 25       | 28-Feb-20|
| A119| Self-help Anxiety Management                          | [link](http://bit.ly/2Q158Wb)  | 500,000    | 4.0    | 2944     | 22-Feb-17|
| A120| Do not panic – Depression and panic help             | [link](http://rb.gy/qz6ve)     | 10,000     | 4      | 383      | 01-Feb-20|
| A121| Live Life: Guided Meditation & relaxation with CBT   | [link](http://rb.gy/nnl0ua)    | 1000       | 4      | 27       | 02-Jan-20|
| A122| Health Log                                           | [link](http://rb.gy/k3i4x9)    | 10,000     | 4      | 394      | 09-Oct-19|
| A123| We are more – our support network                    | [link](http://rb.gy/hg0xd)     | 10,000     | 4      | 402      | 24-Feb-20|

### Table A.15
Selected iOS apps. Part 1.

| ID  | App's name                                           | App's link                     | Rating | # Raters | Update   |
|-----|------------------------------------------------------|--------------------------------|--------|----------|----------|
| 11  | Meditation and Relaxation Pro by FITNESS22 LTD       | [link](http://apple.co/2S0wuvM) | 5.0    | 9        | 03-Jan-19|
| 12  | Relax &Sleep Well Hypnosis by Diviniti Publishing Ltd| [link](http://apple.co/2VO9n8V) | 5.0    | 6        | 10-Oct-19|
| 13  | Atmosphere: Relaxing Sounds by Pocket Studios        | [link](http://apple.co/3e8BIE)  | 5.0    | 6        | 16-Oct-19|
| 14  | Connected Breath by Marc B                           | [link](http://apple.co/3e8I5)   | 5.0    | 6        | 13-Feb-19|
| 15  | Clementine by Lewis &Palmer Ltd.                     | [link](http://apple.co/3e8O0M)  | 5.0    | 5        | 22-Feb-20|
| 16  | Waking Up: A Meditation Course by Waking Up Course, LLC | [link](http://apple.co/2Ryi1R) | 4.9    | 32       | 11-Mar-20|
| 17  | Youper by Youper, Inc.                               | [link](http://apple.co/3e8N2H)  | 4.9    | 30       | 04-Mar-20|
| 18  | Zen: Meditation &Sleep by MoveNext, Ltd              | [link](http://apple.co/2KmK8C)  | 4.9    | 17       | 11-Mar-20|
| 19  | Abide – Christian Meditation by Carpenters Code Inc. | [link](http://apple.co/3e8Hyx)  | 4.9    | 142      | 11-Mar-20|
| 110 | Breathe – 1 min Meditation by Slay                   | [link](http://apple.co/34XkDe)  | 4.9    | 10       | 25-Apr-19|
| 111 | Stop, Breathe &Think by Stop, Breathe & Think        | [link](http://apple.co/34VTAG)  | 4.9    | 51       | 26-Feb-20|
| 112 | Color4u: Adult Colouring Games by Cool Games Limited | [link](http://apple.co/2RvpxP)  | 4.9    | 7        | 10-Mar-20|
| 113 | Pazi – Sleep, Nap, Focus by pazi                     | [link](http://apple.co/3a8O8b)  | 4.9    | 15       | 17-Dec-19|
| 114 | Poly Island: Coloring Art Book by Huckleberry BV      | [link](http://apple.co/2wW2VE)  | 4.9    | 9        | 08-Jan-20|
| 115 | Cross-Stitch: Color by Number by BINGJIA LIANG      | [link](http://apple.co/2VQ5sMN) | 4.9    | 21       | 27-Dec-19|
| 116 | Breeze – Meditation &Sleep by PentalHealth Tech HK Co., Limited | [link](http://apple.co/2RKZwJC) | 4.8    | 6        | 24-Sep-19|
| 117 | Scratchable – Anti-stress Game by Apalon Apps        | [link](http://apple.co/3aHm2Z)  | 4.8    | 16       | 17-Oct-19|
| 118 | Mindfulness with Petit Bambou by FeelVeryBien        | [link](http://apple.co/2VSTWMV) | 4.8    | 29       | 12-Feb-20|
| 119 | 7 Cups: Anxiety &Stress Chat by 7 Cups of Tea        | [link](http://apple.co/3ax99Vx) | 4.8    | 16       | 04-Mar-20|
| 120 | Adult Coloring Book Color Page by MingMing Fan       | [link](http://apple.co/2W2Svt)  | 4.8    | 8        | 10-Oct-19|
| 121 | Super Slime Simulator by Dramatons LTD               | [link](http://apple.co/3bUu21)  | 4.8    | 2100     | 19-Feb-20|
| 122 | I Love Hue by Zat Games Ltd                         | [link](http://apple.co/3eILJmz) | 4.8    | 33       | 19-Feb-19|

(continued on next page)
### Table A.15 (continued)

| ID  | App's name                          | App's link             | Rating | # Raters | Update    |
|-----|-------------------------------------|------------------------|--------|----------|-----------|
| 123 | Mindfulness Daily by inward inc     | http://apple.co/35i09Wq| 4.7    | 10       | 04-Nov-19 |
| 124 | My Oasis: Calming and Relieving by Buff Studio Co.Ltd. | http://apple.co/3bskJj| 4.7    | 31       | 04-Mar-20 |
| 125 | Meditation Studio by InteraXon Taps | http://apple.co/2Rwhk5sO| 4.7    | 6        | 06-Feb-20 |
| 126 | Motivation – Daily quotes by Monkey | http://apple.co/2XSwF09| 4.7    | 1400     | 16-Mar-20 |
| 127 | Lake: Colouring Books by Lake Coloring | http://apple.co/3buv30V| 4.7    | 619      | 21-Mar-20 |
| 128 | Unicorn Slime Simulator by Shake It | http://apple.co/3art0Jm| 4.7    | 32       | 19-Feb-20 |

### Table A.16

Selected iOS apps. Part 2.

| ID  | App's name                          | App's link             | Rating | # Raters | Update    |
|-----|-------------------------------------|------------------------|--------|----------|-----------|
| 129 | Aura: Meditation &Mindfulness by Aura Health Inc. | http://apple.co/2Y3f2um| 4.6    | 87       | 02-Mar-20 |
| 130 | Breethe: Meditation &Sleep by OMG. I Can Meditate! Inc. | http://apple.co/2Vsewo2| 4.6    | 138      | 09-Mar-20 |
| 131 | Zen Sand: Relaxing Games by Antti Lehtinen | http://apple.co/2wW4IJA| 4.6    | 14       | 11-Dec-19 |
| 132 | Moshi Twilight Sleep Stories by Mind Candy Ltd | http://apple.co/2RY7AwZ| 4.6    | 30       | 11-Mar-20 |
| 133 | Reflectly by Reflectly | http://apple.co/2Vx1aas| 4.6    | 243      | 01-Mar-20 |
| 134 | Soulvana: Spiritual Meditation by Mindvalley Creations Inc. | http://apple.co/2Vqo5VB| 4.5    | 15       | 02-Mar-20 |
| 135 | BetterHelp – Online Counseling by BetterHelp | http://apple.co/2VrMcL| 4.5    | 49       | 03-Mar-20 |
| 136 | Stress Anxiety Relief Games by ROMAN SAFRONOV | http://apple.co/2XY3G5U| 4.5    | 29       | 09-Jul-17 |
| 137 | Colorfly: Coloring Book by JoyCastle | http://apple.co/2XVzPv7| 4.5    | 21       | 10-Mar-20 |
| 138 | Relaxing Book: Pixel by Number by Dao Thang | http://apple.co/3bVjQ6J| 4.5    | 15       | 26-Dec-19 |
| 139 | TeasEar – ASMR Slime Simulator by Facemetrics Limited | http://apple.co/2RVWT1u| 4.4    | 216      | 05-Mar-20 |
| 140 | Harmony Hypnosis Meditation by Darren Marks | http://apple.co/3eHhKs5| 4.4    | 5        | 06-Dec-19 |
| 141 | AntiStress Anxiety Relief Game by CONTENT | http://apple.co/2zf8wG6| 4.4    | 13       | 12-Mar-20 |
| 142 | Present – Guided Meditation by Meditation to Relax and Sleep – – Mindfulness Free App | http://apple.co/3eHhtn7| 4.3    | 219      | 21-Nov-19 |
| 143 | Recolor Coloring Book to Color by Sumoing Ltd | http://apple.co/2V988Bd| 4.2    | 168      | 20-Feb-20 |
| 144 | Colorfull – Calm Coloring Book by Amelia and Co | http://apple.co/3atB1mf| 4      | 23       | 17-Mar-20 |
D.E. Shaw, A. Wardlaw, D. Price, I. Pavord, Breathing exercises for asthma: a randomised controlled trial, Thorax 64 (2009) 55–61.

[55] F. Moradipanah, E. Mohammadi, A. Mohammadi, Effect of music on anxiety, stress, and depression levels in patients undergoing coronary angiography, EMHU – East. Mediterr. Health J. (2009) 639–647.

[56] A. de la Torre-Luque, R.A. Caparros-Gonzalez, T. Bastard, F.J. Vico, G. Buela-Casal, Acute stress recovery through listening to melonics relaxing music: a randomized controlled trial, Nord. J. Music Therapy 26 (2017) 124–141.

[57] W.E. Knight, N.S. Rickard, Relaxing music prevents stress-induced increases in subjective anxiety, systolic blood pressure, and heart rate in healthy males and females, J. Music Therapy 38 (2001) 254–272.

[58] J.M. White, Effects of relaxing music on cardiac autonomic balance and anxiety after acute myocardial infarction, Am. J. Crit. Care 8 (1999) 220.

[59] D. Elliott, R. Polman, R. McGregor, Relaxing music for anxiety control, J. Music Therapy 48 (2011) 264–288.

[60] W.B. Gudykunst, Bridging Differences: Effective Intergroup Communication, Sage, 2004.

[61] G.A. Marlatt, J.L. Kristeller, Mindfulness and Meditation, American Psychological Association, 1999.

[62] J.K. Zinn, Wherever you go, there you are: mindfulness meditation in everyday life, Hyperion (1994) 78–80.

[63] M.M. Linehan, Skills Training Manual for Treating Borderline Personality Disorder, Guilford Press, 1993.

[64] R.A. Baer, Mindfulness training as a clinical intervention: a conceptual and empirical review, Clin. Psychol.: Sci. Pract. 10 (2003) 125–143.

[65] S.G. Hofmann, A.T. Sawyer, A.A. Witt, D. Oh, The effect of mindfulness-based therapy on anxiety and depression: a meta-analytic review, J. Consult. Clin. Psychol. 78 (2010) 169.

[66] A.M. Tacón, J. McComb, Y. Caldera, P. Randolph, Mindfulness meditation, anxiety reduction, and heart disease: a pilot study, Fam. Commun. Health 26 (2003) 25–33.

[67] J. Greenson, J. Brantley, Mindfulness and anxiety disorders: developing a wise relationship with the inner experience of fear, Clinical Handbook of Mindfulness, Guilford Press, 1993.

[68] N.T. Van Dam, A.L. Hobkirk, S.C. Sheppard, R. Aviles-Andrews, M. Earleywine, How does mindfulness reduce anxiety, depression, and stress? An exploratory examination of change processes in wait-list controlled mindfulness meditation training, Mindfulness 5 (2014) 574–588.

[69] B.D. Ostafin, J.J. Brooks, L. Laitem, Affective reactivity mediates an inverse relation between mindfulness and anxiety, Mindfulness 5 (2014) 520–528.

[70] A. Desrosiers, V. Vize, D.H. Klemanski, S. Nolen-Hoeksema, Mindfulness and emotion regulation in depression and anxiety: common and distinct mechanisms of action, Depress. Anxiety 30 (2013) 187–196.

[71] J. DiMauro, J. Domingues, G. Fernandez, D.F. Tolin, Long-term effectiveness of CBT for anxiety disorders in an adult outpatient clinic sample: a follow-up study, Behav. Res. Ther. 51 (2013) 82–86.

[72] C. Otte, Cognitive behavioral therapy in anxiety disorders: current state of the evidence, Dialogues Clin. Neurosci. 13 (2011) 413.

[73] E.B. Fea, R.O. Rothbaum, Treating the Trauma of Rape: Cognitive-Behavioral Therapy for PTSD, Guilford Press, 2001.

[74] D.A. Clark, Cognitive-Behavioral Therapy for OCD, Guilford Press, 2004.

[75] C.S. Ho, C. Chee, R. Ho, Mental Health Strategies to Combat the Psychological Impact of Coronavirus Disease 2019 (COVID-19) Beyond Paranoia and Panic, Annals, Academy of Medicine, Singapore, 2020.

[76] A. Vickers, C. Zollman, D.K. Payne, Hypnosis and relaxation therapies, West. J. Med. 175 (2001) 269.

[77] M. Plaskota, C. Lucas, R. Evans, K. Pizzoferro, T. Saini, K. Cook, A hypnotherapy intervention for the treatment of anxiety in patients with cancer receiving palliative care, Int. J. Palliat. Nurs. 18 (2012) 69–75.

[78] T. Kraft, Use of hypnotherapy in anxiety management in the terminally ill: a preliminary study, Br. J. Exp. Clin. Hypn. (1990).

[79] R.A. Chapman, The Clinical Use of Hypnosis in Cognitive Behavior Therapy: a Practitioner's Casebook, Springer Publishing Company, 2005.

[80] S. Deterting, M. Sicart, L. Nacke, K. O'Hara, D. Dixon, Gamification. Using game-design elements in non-gaming contexts, CHI'11 Extended Abstracts on Human Factors in Computing Systems (2011) 2425–2428.

[81] A. Rizzo, J. Paur, K. Graap, B. Manson, P.J. McNerney, B. Wiederhold, M. Wiederhold, J. Spira, A virtual reality exposure therapy application for Iraq war military personnel with post traumatic stress disorder: from training to toy to treatment, NATO Secur. Through Sci. 78 (2010) 169.

[82] C.M. Monson, P.P. Schnurr, P.A. Resick, M.J. Friedman, V. Young-Yu, S.P. Stevens, Cognitive processing therapy for veterans with military-related posttraumatic stress disorder, J. Consult. Clin. Psychol. 74 (2006) 896.

[83] H.M. Zinrow, J.O. Brooks, P.J. Rostopa, S. Jeffirs, C. Jenkins, J. Seazan, A. McKeeman, L.F. Hodges, Virtual reality and cognitive-behavioral therapy for driving anxiety and aggression in veterans: a pilot study, Cognit. Behav. Pract. 25 (2018) 296–309.

[84] R.C. Kessler, J.D. McLeod, Social Support and Mental Health in Community Samples, Academic Press, 1985.

[85] B.W. Penninx, T. Van Tilburg, A.J.P. Boeke, D.M. Kriegsman, J.T.M. Van Dijk, Factors in Computing Systems (2011) 2425–2428.

[86] E.B. Foa, B.O. Rothbaum, Treating the Trauma of Rape: Cognitive-Behavioral Therapy for PTSD, Guilford Press, 2001.

[87] D.E. Conroy, C.-H. Yang, J.P. Maher, Behavior change techniques in top-ranked mobile apps for physical activity, Am. J. Prevent. Med. 46 (2014) 649–652.

[88] E.M. Pattison, R. Llamas, G. Hurd, Social network mediation of anxiety, Psychiatr. Ann. 9 (1979) 56–67.

[89] D.E. Conroy, C.-H. Yang, J.P. Maher, Behavior change techniques in top-ranked mobile apps for physical activity, Am. J. Prevent. Med. 46 (2014) 649–652.

[90] S. Ouhbi, J.L. Fernández-Alemán, J.M. Carrillo-de Gea, A. Toval, A. Idri, E-health internationalization requirements for audit purposes, Comput. Methods Programs Biomed. 144 (2017) 49–60.

[91] B.K. Tran, A.K. Dang, P.K. Thai, H.T. Le, et al., Coverage of health information by different sources in communities: implication for COVID-19 epidemic response, Int. J. Environ. Res. Public Health 17 (2020) 3577.