An overview of the emerging evidence for MHapps

App Usage Data

Studies captured app usage or engagement data in a range of ways. Less than half of the total studies collected objective app usage data (e.g. time spent using the app or time spent using specific app features) (*k* = 23, 44%) [20,21,23,52,67,70,72,73,74,78,79,83,87,88,89,92,93,97,98,100,116,117,130]. Other studies used other measures such as participant diaries or short questionnaires to record app usage (*k* = 16, 31%) [66,69,71,76,80,81,82,85,86,90,91,101,103,105,107,129]. Some studies did not report app usage data, or it was unclear (*k* = 13, 25%) [64,65,68,75,77,84,94,95,96,99,108,113,114].

Mental Well-being

RCTs

A randomized study design was used to examine the effectiveness, acceptability, or feasibility of four MHapps targeting mental well-being outcomes across four articles [1–4]. Participants were recruited in educational settings (*k* = 2), online (*k* = 1), and from the community (*k* = 1). The methodological quality of the included studies ranged from 1 to 4 (out of a possible 5). To be eligible for inclusion in the studies, participants had to be 18 years or older, own a smartphone, have no history of mental health disorders, have regular access to the internet and an email account, and be willing to provide written consent [1–4]. Studies reported varying recruitment periods and intervention use periods up to 12 weeks [2]. A significant increase in overall [66] and family/community [66] well-being was reported after app use, compared to controls, in two randomized control trials [2,4]. Adherence to the apps varied and was measured by participation or usage (87.69%, 41.9%) or response to app notifications (significantly higher in females (M = 114.1, *SD* = 37.2) than males (M = 72.4, *SD* = 47.4)). Common limitations reported by the primary studies included the limited ability to capture which aspects of the intervention contributed to mood changes (as app user journeys were not tracked) [3,4], relatively high dropout rates without data for reasons for attrition [4], and relatively homogenous populations [2,3].

Nonrandomized Studies

A nonrandomized study design was used to examine the effectiveness of one app targeting mental well-being [5]. Researchers adopted a quasi-experimental design, obtaining pre and post-test data. Participants were recruited online. The methodological quality of the study was 2 (out of a possible 5). To be eligible for inclusion in the study participants had to be current app users. This study reported an intervention use period of at least 12 days (recommended by the researchers) rather than a strict limit. A significant increase in self-esteem and mood ratings was reported after app use. Adherence to the app was low, with Giraldo-O'Meara and Doron (2020) reporting over 80% dropout almost halfway through the levels of the intervention.

Mental Health

RCTs

A randomized study design was used to examine the effectiveness, acceptability or feasibility of 18 apps targeting mental health outcomes (e.g. anxiety, depression and stress) across 10 articles [6–15]. Participants were generally recruited in educational settings (k = 4) and online (k = 3). The methodological quality of the included studies ranged from 1 to 4. Studies reported varying recruitment periods and intervention use periods ranging from 4 weeks [13] to 6 weeks [7]. A significant decrease in mental health symptoms was generally reported after app use [13]. Adherence to apps varied from 21% to 100% across studies. More specifically, Birney et al (2016) reported participants logged into the *MoodHacker* app 16.0 times (SD= 13.3) for a total of 1.3 hours (SD= 1.3). Lower adherence rates were associated with higher anxiety and depression in Arean et al.'s (2016) study. Common limitations included participants not downloading the app after completing baseline assessments, attrition across the studies, small sample size, short duration of the intervention, and homogeneity of the sample population making generalization difficult [13].

Emotion Regulation

Mixed Methods

A mixed methods study design obtaining qualitative and quantitative data was used to examine the effectiveness of one app which targeted emotion regulation [75]. This study reported preliminary findings from pilot research as part of a field study. Participants were recruited in a clinical setting. The methodological quality of this study was 4 out of a possible 5. Health coaches provided information about the study to people that they thought might be interested in participating. The study reported an intervention use period of one month [16]. Significant increases in emotion regulation and self-awareness were reported after app use [16]. No adherence data were reported.

Integrated Outcomes

RCTs

A randomized study design was used to examine the effectiveness, acceptability or feasibility of 29 apps targeting emotional regulation, mental health and well-being outcomes across 25 articles [17,18,27–36,19,37,20–26]. Seven studies reported preliminary findings from pilot or feasibility research [20,21,26,37,38,40,41]. Participants were generally recruited in educational settings (k = 12) and online (k = 7). The methodological quality of the included studies ranged from 1 to 4. Studies reported varying recruitment periods and intervention use periods from 10 days [23] to 8 weeks [33]. A significant increase in well-being, mental health and ER outcomes was generally reported after app use, compared to controls or to other interventions [19,20,22,24,26,39,40]. Adherence to app use and retention in the research varied between 14-100%. Lower retention rates were reported for studies reporting findings from 3 and 4 month follow ups. Higher adherence rates were found in studies that reported on usage of the app at least once or those reporting a sign up or creation of an account. Adherence was generally based on completion of research outcome measures, self-report usage or software built on the backend of the app itself. Some studies reported the average number of days or number of times a specific task was completed [17,24,26,35,40,42]. Reasons for low adherence were mainly reported as ‘reasons unknown’ or failing to complete outcome measures. Common limitations included high rates of attrition, not investigating the effectiveness of apps beyond the intervention period, biased samples (e.g. self-selected or only included undergraduate students, females, or majority White participants). In some instances, the primary authors noted that the research team was not formally blinded to app allocation or the sample sizes were not sufficiently powered to identify between-group differences [29,36].

Nonrandomized Studies

A nonrandomized study design was used to examine the effectiveness, acceptability, or feasibility of nine MHapps across nine articles [18,43–49]. Researchers generally adopted a quasi-experimental design obtaining pre and post-test data. Five studies reported preliminary findings from pilot or feasibility research [34,45,48–50]. Participants were generally recruited online (k = 5). The methodological quality of these studies ranged from 2 to 5. Studies reported varying recruitment periods and intervention use periods from 2 weeks [48] to 5 weeks [44]. A significant increase in well-being, mental health and ER outcomes was generally reported after app use, compared to controls or to other interventions [18,43,50]. Adherence to app use and retention in the research also varied, reporting about 40-57% in alpha and beta testing [44] or about 80% in a larger study [49]. One study using a small sample (n = 11) of volunteers was able to retain all participants [51]. Studies also reported app use ranging from once per day over a 2-week study period to an average of 5.15 (SD = 6.08) times over a 4-week period [48,50]. Another study reported that paid participants used the app on more days, completed more tasks, and had a longer total duration of use than unpaid participants [45]. Reported limitations included small sample sizes or difficulty to identify which component of the studied app led to a change in outcomes [45,51]. Other studies reported issues with small sample sizes that were primarily White female participants and variation in the extent that participants used the app during the study period [48].

Mixed Methods

Mixed methods study designs were used to examine the two apps [46,52]. Following other study designs, the two studies reported preliminary findings from pilot or feasibility research. Similarly, participants were recruited in educational settings (e.g. a university). The methodological quality of these studies were 4 and 5. To be eligible for inclusion in the study participants had to be at least 18 years of age, not be in receipt of any psychological treatment including any psychopharmacological drugs — or if doing so, be on a fixed dose for more than one month —, and have continuous access to an iPhone or simply being interested in stress management and willing to use a prototype mobile app. Studies reported varying recruitment periods and intervention use periods from 2 weeks to 1 month [46,52]. A significant change in well-being and mental health outcomes (increased satisfaction with life and reduced stress but not anxiety) were generally reported after app use [46,52]. Similar to other study types, adherence to app use and retention in the research were moderate, with studies reporting 38-50% active users within 2 weeks to 1-month periods, and average session durations of about 12.3 (*SD* = 5.2, range = 4.4-24) minutes. Qualitative findings generally described themes of acceptability, benefits such as learning mindfulness, changing attitudes and barriers to usage [46,52]. Common limitations included a small sample size, a short intervention period, lack of an active control group, not using the app on participants' own phone (so deviating from naturalistic conditions), and not being able to account for confounding factors in the study [46,52].

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