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# Testing an App-Assisted Treatment for Suicide Prevention in a Randomized Controlled Trial: Effects on Suicide Risk and Depression

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**Suicide is a global public health problem and effective psychological interventions are needed. The objective of the present study was to evaluate the effect of an app-assisted suicide prevention treatment on suicide risk and depression. One hundred twenty-nine participants were randomized to treatment as usual (TAU), consisting of psychotherapy adhering to the framework of Collaborative Assessment and Management of Suicidality (CAMS), with (TAU+APP, $N = 60$) or without (TAU, $N = 69$) access to a mobile application (i.e., LifeApp'tite). Suicide risk and symptoms of depression were assessed pre- and posttherapy, and at 4-month follow-up. The TAU+APP group showed a smaller decrease on self-reported suicide risk at the end of treatment, corresponding to a medium between-group effect size ($p = .008$, $d = 0.46$). At the 4-month follow-up this was the case only at the trend level, where the effect size was also of a smaller magnitude ($p = .057$, $d = 0.30$). No differences between the treatment groups were observed on self-reported depressive symptoms, either immediately following treatment ($p = .732$, $d = 0.05$) or at follow-up ($p = .467$, $d = 0.11$). The unexpected negative effect concerning suicide risk points to crucial consideration of issues pertaining to timing, dosing, and content when adding new technology to existing treatments both in this and other populations.**

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Suicide is a global public health problem with close to 1 million individuals dying from suicide annually and 20 times more suicide attempts (Scott & Guo, 2012). Reducing suicidal ideation and preventing suicide attempts and suicide have thus been the primary aim of a growing number of psychosocial interventions (Comtois et al., 2011; Hawton et al., 2016; Scott & Guo, 2012; Turecki & Brent, 2016; Zalsman et al., 2016), demonstrating positive results across a variety of settings (e.g., outpatient care, inpatient units) and populations (e.g., youth and adults with and without other psychopathology). However, this body of literature is still relatively small and suffers from a number of methodological limitations including nonrandomized designs, a failure to replicate studies, and concerns around the generalizability (Hawton et al., 2016; Turecki & Brent, 2016).

In recent years, psychotherapy research has seen a rapid growth in therapies incorporating Web and mobile applications (apps), and previous research indicates that such app services can be used effectively as both stand-alone treatments and supplements to more established treatments for a variety of psychiatric conditions, such as depression, anxiety, and stress (e.g., Andersson et al., 2014; Barak, Hen, Boniel-Nissim, & Shapira, 2008; Donker et al., 2013). A number of benefits to these Web-/app-based treatments include flexibility of use (e.g., at

home), proximity of help, ability to repeat certain lessons/modules, potential of reaching populations that otherwise would not have access to mental health services, dissemination of highly specialized treatment methods, and cost-effectiveness (e.g., Andersson et al., 2014; Donker et al., 2013).

Treatments aimed at suicide prevention have also begun to explore the utility of Web-/app-based or -assisted treatments (e.g., Donker et al., 2013; Lai, Maniam, Chan, Ravindran, & Res, 2014). A recent review showed preliminary evidence of the benefit of Web-based interventions within this population (Lai et al., 2014)—however, the review included only two randomized controlled trials (RCTs; Christensen et al., 2013; van Spijker, Majo, Smit, van Straten, & Kerkhof, 2012; van Spijker, van Straten, & Kerkhof, 2014), with only one of these primarily targeting suicide prevention. Another review (Menon, Rajan, & Sarkar, 2017) was able to locate an additional RCT, testing the effect of a mobile phone-based psychotherapy on individuals following hospitalization for suicide attempt (Marasinghe et al., 2012), finding no effect on suicidality or depressive symptoms. Finally, Franklin and colleagues (2016), across three different studies, tested the effect of a gamelike app against a control app and found a significant effect of the gamelike app on reductions in suicide plans and suicidal behaviors but not suicide ideation. The detected effects were not maintained at the 1-month follow-up.

Taken together, more studies are clearly needed before reaching any conclusions as to the effectiveness of Web-/app-based and -assisted suicide prevention treatments. As of now, only two RCTs exist, and the present study thus adds to this very young field. Our aim was to test the potential augmenting effect of a mobile app (i.e., LifeApp'tite), containing functionalities aligning with the content of therapy, ensuring fast access to a number of important tools (e.g., safety plan), and designed to serve as a supporting guide through additional psychoeducation and various therapeutic methods (e.g., problem solving). Many individuals carry their smartphone most of the time, and a mobile app is therefore not only portable but also often readily available. As such, it provides great flexibility of use and holds the potential to improve adherence to treatment (e.g., Donker et al., 2013; Harrison et al., 2011). For individuals at risk of death by suicide, the availability and portability may be of special value in case of suicidal impulses and acute suicidal thoughts.

## Aim of the Study

The primary objective of this study was to compare the effect between treatment as usual (TAU) with (TAU + APP) and without (TAU) the assistance of the mobile app (i.e., LifeApp'tite) on individuals referred to out-patient suicide prevention treatment. We hypothesized that the TAU + APP group, compared with the TAU group, would show a larger decrease on the two primary outcomes—namely, suicidal risk and symptoms of depression. This was hypothesized to be the case both following the acute treatment period and at 4-month follow-up. In addition, a number of moderation analyses were planned, where the aim was to investigate whether a potential interaction effect was moderated by gender, age, and usage of the mobile app, measured as total number of clicks and total number of methods used, and evaluation of the mobile app.

## Material and Methods

### PARTICIPANTS

The current study took place at a specialized outpatient suicide prevention clinic located at a psychiatric university hospital in Denmark from April 2014 through November 2016. The clinic provides psychosocial therapy for people at risk of suicide, typically presenting with adjustment disorders and mild to moderate depression. Inclusion criteria were referral to evaluation/treatment at the clinic due to current suicidal thoughts with or without a history of suicide attempt, between ages 18 and 65, access to a personal smartphone supporting the mobile app, and presenting with symptoms where a brief psychotherapeutic out-patient intervention was deemed appropriate. Symptoms of mild to moderate anxiety, depression, and adjustment difficulties were allowed. Exclusion criteria were current severe psychopathology (e.g., severe depression, bipolar disorder, primary psychotic disorder), current substance abuse, need for inpatient treatment, and participation in other relevant psychotherapy. All participants were diagnostically screened, assessed with the Major Depression Inventory (MDI; Olsen et al., 2003), and discussed with a medical specialist in psychiatry at a weekly internal conference. All formal diagnoses were based on ICD-10 criteria (World Health Organization, 1992).

Expecting a small effect size ($d$ = 0.2), an a priori power calculation required a total of 214 participants to be able to detect a significant between-group effect from pre- to immediately posttherapy with a 2 (time) × 2 (groups) analysis of variance. During the study period, fewer than expected participants were eligible for inclusion and the inclusion period was therefore terminated before reaching the target ($N$ = 129).

### MATERIALS

#### *Primary Outcomes*

*Suicide Risk.* Suicide risk was measured by the Suicide Status Form II–R (SSF; Conrad et al., 2009;

Jobes, Jacoby, Cimbolic, & Hustead, 1997). The scale consists of six items rated on a 5-point Likert scale, including psychological pain, stress, agitation, hopelessness, self-hate, and overall risk of suicide. Cronbach's alpha for the first completed SSF was .74.

*Depression.* Depression was measured by the MDI (Olsen et al., 2003). The scale consists of 10 items—however, 2 items are divided into 2 subitems (appetite and sleep rated as increased and decreased) where only the highest scores of those items are included in the total score. Cronbach's alpha for the first completed MDI was .80. Both primary outcomes exist in authorized and validated Danish versions.

*Secondary Outcomes and Moderators*

*App Evaluation.* App evaluation was measured on a 6-point scale from −3 to +3 at the 4-month follow-up. Participants were asked to evaluate their perceived role of the app in the psychotherapeutic intervention from negative to positive.

*Total App Activity.* Total app activity was calculated as the sum of all clicks regardless of the type of click.

*Usage of Methods Library.* Usage of the methods library was calculated as the mean number of methods used. There had to be at least one click inside a specific method's module to count as usage of that particular method. The total number of methods offered was 43 (see description of methods below).

## INTERVENTION

*Treatment as Usual (TAU)*

The treatment provided at the out-patient clinic is an eclectic, supportive, problem-solving-oriented psychotherapy, adhering to the framework of Collaborative Assessment and Management of Suicidality (CAMS; Erlangsen et al., 2015; Jobes, 2016). CAMS provides a therapeutic framework for suicide-specific assessment and treatment of a patient's suicidal risk, cutting across theoretical orientations and disciplines, ensuring a continuous focus on suicide prevention. Compared to no therapy, the treatment offered in this study has been found to be effective in lowering the risk of self-harm and death (Erlangsen et al., 2015). A typical intervention at the clinic runs over the course of eight sessions, typically planned as weekly sessions, but the specific number of sessions is decided at the discretion of the therapist. During the intervention period, six therapists provided treatment. Five were clinical psychologists and one was a social worker. All had more than 4 years of work experience, and all met for 3 hours of supervision per month. Supervision was led by the leading psychologist and/or a medical doctor and concerned diagnostic, medical, and treatment issues.

*LifeApp'tite Mobile App*

The mobile app was designed to serve a number of functions. First, it provided psychoeducation for both the patient and his or her loved ones concerning suicidal thoughts and ways to handle situations and reactions pertaining to such. Second, a number of self-rating scales were available, including MDI and SSF, and the mobile app sent out automated notifications as reminders of questionnaire completion during the active treatment period. In addition, users were asked to complete daily records of their sleep, appetite, and stress levels. Third, a so-called safety plan (Stanley & Brown, 2012), describing specific actions to be taken in case of severe suicidal thoughts and impulses between the sessions, was developed in collaboration between therapist and patient. Fourth, users were asked to create a digital hope kit, containing positive memories and thoughts for times of overwhelming hopelessness. Fifth, quick access to an overview of places to seek help in case of severe suicidal thoughts. Sixth, a methods library divided into two sections of self-help exercises. One section consisted of methods targeting current issues, the other had methods for planning and creating a better life. The specific methods included problem solving, changing perspectives, distraction, mindfulness and acceptance, self-soothing, decreasing social isolation, planning pleasurable activities, and strengthening social competences. The mobile app notified the user daily to rate his or her mood after which it suggested the use of a method based on random generation.

The mobile app was designed and developed in collaboration between C.M.P. from the Suicide Prevention Clinic and a local software company. This company was also in charge of technical support and data handling during the study period.

## STATISTICAL ANALYSES

Mixed linear models (MLMs) were chosen to compare groups over time on the two dependent variables. All MLMs were based on the intent-to-treat sample, and participants appeared with their number of completed records without any data imputation or other handling of missing records (cf. Chakraborty & Gu, 2009). Given the varying number of sessions completed, MLMs are especially suited for analyzing these types of data.

A two-level model with time nested within individuals was specified. The time variable went

from 1 to 25, corresponding to the maximum number of sessions. Fixed effects were specified for intercept, time, group (TAU or TAU + APP), and a Time × Group interaction. All models also included a random intercept and slope, as this improved the model fit evaluated by a significant change in the –2LL fit statistics (cf. Heck, Thomas, & Tabata, 2010). The time variable was entered as a log transformation of the time points as this improved the model fit, which is sometimes the case in psychotherapy research, where the steepest change occurs at the beginning of therapy (cf. Tasca, Illing, Joyce, & Ogrodniczuk, 2009). A significant intervention effect is indicated by a two-way interaction between treatment group and time.

A number of treatment moderators were then explored as either two-way interaction terms (Time × Moderator), when measures were only available in the treatment group (i.e., total number of clicks, total number of methods used), or three-way interaction terms (Time × Group × Moderator), when measures were available in both groups (i.e., gender and age).

When detecting a significant between-group difference on the primary outcomes, a reliable change index was calculated (cf. Jacobson & Truax, 1991).

Effect sizes were expressed as Cohen's *d*, where 0.2, 0.5, and 0.8 were considered a small, medium, and large effect size, respectively. Cohen's *d* was derived from the *F* test calculated as $d = 2^*\sqrt{(F/ddf}$; Verbeke & Molenberghs, 2009). All MLMs were estimated with the maximum likelihood method, and IBM SPSS statistics version 24 (IBM, 2016) was used for all analyses.

Mean substitution was chosen as the method to handle single missing items on the two dependent variables (cf. Schafer, Graham, & Psychol, 2002). If a case had more than 50% missing data on the scale, no mean substitution was performed.

### PROCEDURE

During the study period, all patients at the clinic were assessed for eligibility. Patients fulfilling the inclusion criteria were orally informed about the project during the first treatment session and also received written information. Upon signed consent, participants were randomized in an unrestricted manner to either the TAU + APP or TAU group. Sealed envelopes were prepared, each holding one of the two randomization results. An administrative assistant at the clinic, unaware of the content of the envelopes, would pick an envelope and open this in the presence of the participant, and all participants were thus aware of condition assignment. Participants randomized to the TAU + APP group were asked to download the mobile app before the second treatment session, where 30 extra minutes were allocated to the introduction of the mobile app. After that, it was at the discretion of the therapists and their clinical evaluation to decide how much and when to use the app. In both groups, the MDI and SSF were completed before each session. Participants randomized to the TAU + APP group were encouraged to complete the questionnaires via the mobile app, whereas participants in the TAU group completed the questionnaires in the beginning of each session. At the final session, participants were informed that they would receive a 4-month follow-up letter with an MDI and SSF to be completed along with a number of questions concerning treatment evaluation to be returned in a stamped envelope. All 4-month follow-up questionnaires were paper questionnaires. Participants were not compensated in any way for participation.

The study protocol and all study procedures were registered and approved by the national data protection agency and the regional ethics committee (M-2012-630-12).[1]

## Results

Two hundred seventy-four individuals were informed about the project and invited to participate. Of these, 145 declined participation, and the remaining 129 individuals were randomized to either TAU ($N = 69$) or TAU + APP ($N = 60$). Of the 129 individuals, 65 (50%) completed the 4-month follow-up measure (see participant flow in Figure 1). Participants were considered treatment dropouts if they completed fewer than three sessions of therapy. No dropouts were due to serious adverse instances during treatment, but other specific reasons for dropout were not systematically collected.

There was no gender difference between nonparticipants (57% women) and participants (65% women), $\chi^2(1) = 2.1$, $p = .148$. However, nonparticipants were significantly older ($M = 32.4$, $SD = 12.8$) than participants ($M = 28.7$, $SD = 9.5$), $t(272) = 2.7$, $p = .008$. Due to the difference in age, main analyses were conducted with and without age as a covariate.

As for the included participants, the most prevalent psychiatric diagnosis (based on ICD-10) was adjustment disorder (F43.2). Ninety-six percent of participants in the TAU group received a primary adjustment disorder diagnosis, compared with 93% in the TAU + APP group. Other diagnoses given were major depressive disorder, single moderate episode (F32.1); major depressive disorder, recurrent, moderate episode (F33.1); and mixed and other personality disorders (F61.1). The two groups did not differ on marital status, previous suicide attempt, previous treatment, age, gender, completed number

[1] The study protocol can be obtained by e-mailing christian.pedersen@ps.rm.dk.

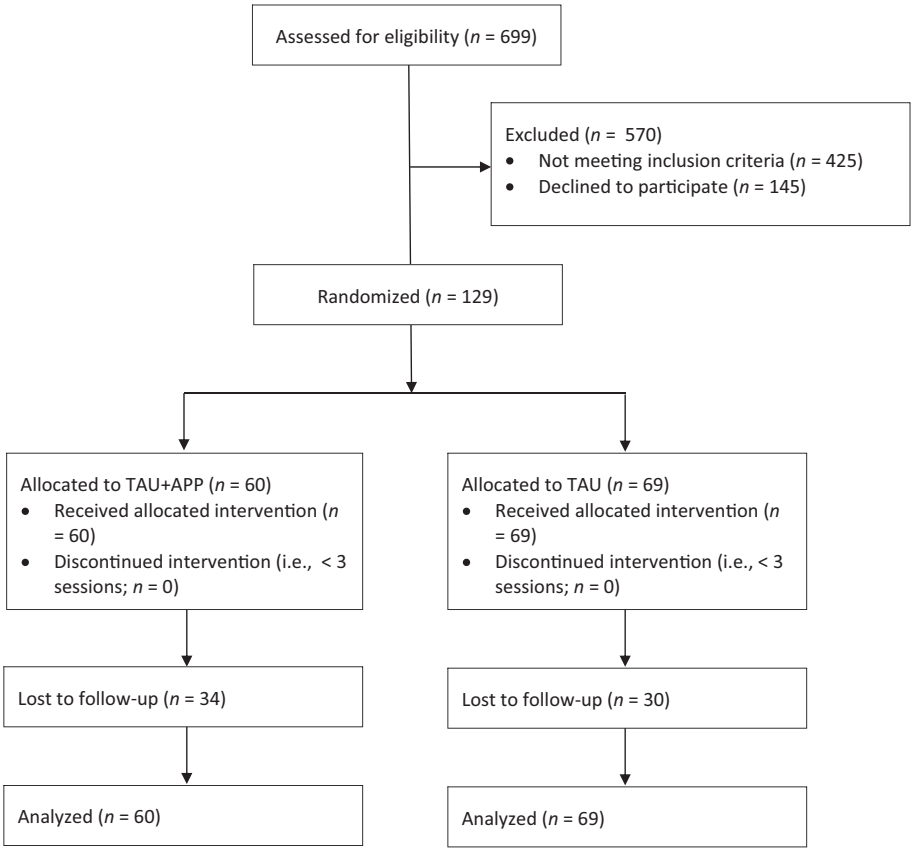


FIGURE 1 Participant flow diagram. *Note*. TAU + APP = treatment as usual in addition to the mobile application; TAU = treatment as usual without the mobile application.

of sessions, or severity on the first MDI or SSF completed, and there was no difference in the distribution between the two groups of participants with and without a personality disorder, $\chi^2(1) = 0.7$, $p = .408$. However, there was a trend toward more participants in the TAU + APP group being a student or employed ($p = .052$; see Table 1).

Participants had an average of 4.4($SD$ = 4.0) missing SSF ratings and an average of 3.4($SD$ = 3.7) missing MDI ratings. Neither baseline SSF, $r < .01$, $p = .987$, nor baseline MDI, $r = -.04$, $p = .703$, was associated with the number of missing records, thus not violating the assumption of data missing at random (Snijders & Bosker, 2012).

Table 1
Participant Descriptives

| | TAU ($N$ = 69) | TAU + APP ($N$ = 60) | $p$ |
|---|---|---|---|
| Percent married | 40 | 49 | .415 |
| Percent employed/student | 42 | 60 | .052 |
| Percent previous suicide attempt (in addition to current referral reason) | 11 | 10 | .832 |
| Percent undergone previous treatment in the clinic | 3 | 4 | .801 |
| Percent undergone any previous psychiatric treatment | 21 | 22 | .816 |
| Age | 29.3 (9.7) | 28.1 (9.2) | .483 |
| Percent women | 44 | 40 | .730 |
| Suicide risk (SSF) | 18.0 (5.0) | 18.7 (4.1) | .457 |
| Depression (MDI) | 32.9 (9.2) | 34.5 (8.3) | .455 |
| Number of sessions | 10.4 (5.2) | 9.4 (4.1) | .211 |

*Note*. TAU = treatment as usual without the mobile application; TAU + APP = treatment as usual in addition to the mobile application; SSF = Suicide Status Form II–R; MDI = Major Depression Inventory.

Of the 60 patients randomized to the TAU+APP group, 50 participants (83%) were active on the mobile app as measured by any number of clicks. Within the group that had been active on the mobile app as indicated by any clicks at all, the mean number of total clicks was 297.9 (*SD* = 180.3). Twenty-three participants (38%) used the methods library. The mean number of methods used within the group that had used any method was 4.0(*SD* = 2.6). Participants used methods pertaining to six categories, including problem solving, changing perspectives, decreasing social isolation, planning pleasurable activities, and strengthening social competences. Participants evaluated the mobile app to play a neutral role, with a mean score of 0.7(*SD* = 1.8) on a 6-point scale from –3 to +3.

### PRIMARY OUTCOMES

Means and standard deviations at the different time points for the two primary outcomes are reported in Table 2. A significant main effect of time on SSF was found across the whole intervention period, where self-reported suicide risk decreased, $F(1, 173.1) = 104.4$, $p < .001$, $d = 1.55$, corresponding to a large effect size. A significant between-group effect was found immediately following therapy, indicated by a significant Time × Group interaction term in predicting SSF, $F(1, 138.7) = 7.2$, $p = .008$, $d = 0.46$, 95% CI [0.86, 5.67], corresponding to a medium effect size. The TAU+APP group experienced a smaller decrease on the SFF, $F(1, 351.1) = 65.0$, $p < .001$, $d = 0.86$ compared with the TAU group, $F(1, 333.0) = 133.7$, $p < .001$, $d = 1.27$. The results remained significant ($p = .010$) when controlling for age. Thirty-one participants (45%) in the TAU group and 20 participants (33%) in the TAU+APP group experienced reliable change. This difference was not significant, $\chi^2(1) = 1.8$, $p = .179$. At the 4-month follow-up, the interaction effects was only borderline significant, $F(1, 168.2) = 3.7$, $p = .057$, $d = 0.30$, 95% CI [–0.05, 3.37], again favoring the TAU group and corresponding to a small effect size. The results remained borderline significant ($p = .062$) when controlling for age. At this follow-up point, 20 participants (30%) in the TAU group and 13 participants (22%) in the TAU+APP group experienced reliable change. This difference was not significant either, $\chi^2(1) = 0.9$, $p = .342$.

Concerning MDI, the main effect of time across the whole intervention period was significant, $F(1, 158.9) = 133.7$, $p < .001$, $d = 1.83$, showing a large decrease across groups in depressive symptoms. No differences over time between the two groups were detected on the MDI either posttherapy, $F(1, 140.3) = 0.1$, $p = .732$, $d = 0.05$, 95% CI [–3.83, 5.44], or at the 4-month follow-up, $F(1, 153.2) = 0.5$, $p = .467$, $d = 0.11$, 95% CI [–2.36, 5.13]. This was also true when controlling for age.

### MODERATION ANALYSES

Given that an interaction effect was found only on SSF, moderation analyses were conducted only with SSF as the dependent variable. Gender did not moderate the effect, as indicated by a nonsignificant three-way interaction term, $F(1, 132.6) = 0.1$, $p = .818$, $d = 0.04$, nor did age, $F(1, 157.2) = 0.2$, $p = .678$, $d = 0.07$, or number of sessions, $F(1, 111.6) = 0.2$, $p = .680$, $d = 0.08$, posttherapy. Similar results were obtained when including the follow-up time point.

Concerning the participants who had used the mobile app measured as any type of clicks ($N = 50$), the total number of clicks was not significant at either posttreatment, $F(1, 46.3) = 1.5$, $p = .228$, $d = 0.36$, or follow-up, $F(1, 50.0) = 0.3$, $p = .559$, $d = 0.15$, although favoring the individuals with *more* clicks. Looking at the individuals who had used the methods library ($N = 23$), the total number of methods used was not significantly associated with the effect, $F(1, 19.1) < 0.1$, $p = .997$, $d = 0.01$, posttreatment. However, at the 4-month follow-up, although the analysis remained nonsignificant, $F(1, 16.6) = 1.3$, $p = .278$, $d = 0.56$, the effect size was of a medium magnitude, favoring participants who used *fewer* methods. There were no differences between individuals using any methods or not in their baseline SSF, $t(52) = 1.2$, $p = .244$, and there was no correlation between number of methods used and baseline SSF $r(21) = –.1$, $p = .818$.

The evaluation of the mobile app did not moderate the effect at either posttherapy, $F(1, 41.7) = 0.1$,

Table 2
Means and Standard Deviations at Pretherapy, Posttherapy, and Follow-Up

| | Pre *M* (*SD*) | | Post *M* (*SD*) | | Follow-Up *M* (*SD*) | |
|---|---|---|---|---|---|---|
| | TAU | TAU+APP | TAU | TAU+APP | TAU | TAU+APP |
| Suicide risk (SSF) | 18.0 (5.0) | 18.7 (4.1) | 12.6 (5.6) | 14.9 (5.7) | 12.7 (5.8) | 14.0 (5.2) |
| Depression (MDI) | 32.9 (9.2) | 34.5 (8.3) | 21.1 (12.7) | 22.6 (13.7) | 18.1 (12.0) | 20.5 (11.4) |

*Note.* *M* = mean; *SD* = standard deviation; TAU = treatment as usual without the mobile application; TAU+APP = treatment as usual in addition to the mobile application; SSF = Suicide Status Form II–R; MDI = Major Depression Inventory.

$p = .780$, $d = 0.09$, or 4-month follow-up, $F(1, 50.0) = 0.1$, $p = .770$, $d = 0.10$.

## Discussion

This study was an RCT testing a mobile app's potential augmenting effect of a suicide prevention program for outpatients with suicidal ideation with or without previous suicide attempts. Contrary to the hypothesis, results showed that the group receiving the mobile app in addition to the standard treatment showed a smaller decrease on self-reported suicide risk at the end of treatment, corresponding to a medium effect size ($d = 0.46$), compared with the TAU group. At the 4-month follow-up this was only the case at the trend level, where the effect size was also of a smaller magnitude ($d = 0.30$). No differences between the treatment groups were observed on self-reported depressive symptoms, either immediately following treatment or at follow-up.

The negative effect concerning suicide risk immediately following treatment is a surprising finding, although only a few studies have evaluated the effect of mobile apps in RCTs (Bakker, Kazantzis, Rickwood, Rickard, & Health, 2016; Donker et al., 2013). Given the design of the present study, the effect of the mobile app as a stand-alone treatment cannot be evaluated, and the discussion below therefore cannot address the mobile app's potential usefulness or adverse effects as such. Keeping this in mind, a number of possibilities for the detected negative effect of the mobile app must be considered.

First, the two groups received the same number of sessions—however, the focus on and work with the mobile app throughout the therapy may have limited the TAU + APP group's dose of the face-to-face treatment, previously established to be effective (Erlangsen et al., 2015). Thus, the negative effect may not point to adverse effects caused by the mobile app itself, but rather reflect a lower dose of an otherwise effective treatment. However, this is difficult to determine since no measure concerning time spent on the mobile app was obtained.

Second, adverse effects could be hypothesized when considering the fact that a vulnerable population in distress and likely to exhibit neuropsychological difficulties (Keilp et al., 2013) is asked to learn and use a new technology or program. This may simply be overwhelming, possibly preventing reduction in the domains pertaining to the suicide risk, such as hopelessness and stress. Along the same lines, the specific methods may have been too difficult to use, or the rationale behind them not explained with sufficient clarity, which is imperative when working with this population (Jobes, 2016). At the same time, it is recommended that mental health mobile apps explicitly recommend activities and coping skills training (Bakker et al., 2016), and much more needs to be learned about when and how to employ which specific methods. Unfortunately, no qualitative measures were obtained that could have addressed participants' experience of the mobile apps' methods. Rather, we simply know from a quantitative perspective that participants evaluated the mobile app to play a neutral role.

Third, there was no manual or guidelines as to *how* the mobile app should be introduced and used throughout treatment, and we therefore do not know how well incorporated the mobile app was in the face-to-face treatment, and whether this led to a positive or negative effect. This may have been a problem for the patient who did not understand the rationale behind and role of the mobile app (Jobes, 2016). The perceived role of the mobile app by the therapists was not evaluated, and some therapists may have found the incorporation of the mobile app problematic, causing extra work and time away from the usual therapy. When it comes to the participants, the role of the mobile app was rated as neutral—however, this evaluation did not moderate the effect.

Fourth, a couple of issues related to timing should be considered. There is a potential timing issue concerning the daily notifications, asking the client to evaluate his or her mood. Such notification could be very helpful at times and at other times potentially turn the participant's focus inward where an external focus would be more adaptive (e.g., Aldao, Sheppes, & Gross, 2015). Another timing issue pertains to the time point of the introduction of the mobile app itself. The mobile app may be better suited later in the treatment or following face-to-face treatment termination. However, the study by Marasinghe and colleagues (2012) did not detect an effect by adding a mobile treatment to the usual care as a follow-up.

Concerning clinical implications, this study points to important issues to consider when adding technology to face-to-face psychological interventions for this and other populations. Clinicians cannot rely on an assumption that the addition of various technologies to existing treatments is unequivocally better, and more research is clearly needed when it comes to the question of timing, dosing, and content in order to understand whether, when, and how to integrate a mobile app in psychotherapy. This study's findings on this particular population may point to self-reported suicide risk being more vulnerable to these issues.

The study suffers from a number of limitations. First, reasons for exclusion or decline of participation

were not registered systematically. Second, individuals below the age of 18 were not included, and results may generalize only to the adult population. Third, inclusion of participants was terminated before the power-calculated target, solely due to a slower inclusion rate than expected within the available time frame for the study, and only half of the participants were retained through follow-up. Fourth, although both modalities rely on self-report, it cannot be ruled out that the different assessment modalities (i.e., paper vs. app questionnaire) is a potential confound. Finally, therapists treated patients in both groups, and treatment fidelity was not evaluated. This also means that, although theoretically adhering to the same therapeutic framework (i.e., CAMS), specific interventions may have differed across the two groups.

Taken together, the potential augmenting effect of a mobile app on suicide prevention treatment was tested in an RCT. Results showed that the group receiving TAU in combination with access to the mobile app experienced a smaller decrease in self-reported suicide risk immediately following treatment, but there was no between-group difference concerning symptom of depression. Adding technology to existing treatments can be problematic, and issues pertaining to timing, dosing, and content are crucial in researching both this and other populations.

## Conflict of Interest Statement

The authors declare that there are no conflicts of interest.

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