Alcohol and Alcoholism, 2019, 54(5) 551–558
doi: 10.1093/alcalc/agz060
Advance Access Publication Date: 30 July 2019
Article

Article

Alcohol Use Disorder and Comorbid Depression: A Randomized Controlled Trial Investigating the Effectiveness of Supportive Text Messages in Aiding Recovery

Helen O'Reilly[1,2], Aisling Hagerty[1], Seamus O'Donnell[1], Aoife Farrell[1], Dan Hartnett[1], Edel Murphy[1], Elizabeth Kehoe[1], Vincent Agyapong[1,3], Declan M. McLoughlin[1], and Conor Farren[1,*]

[1]Department of Psychiatry, Trinity College Dublin, St. Patrick's University Hospital, Dublin, Ireland, [2]Department of Psychology, University College Dublin, Ireland, and [3]Department of Psychiatry, University of Alberta, Alberta, Canada

*Corresponding author: St Patrick's University Hospital, James Street, Dublin 8, Ireland. Tel: +3531 2493444; E-mail: cfarren@stpatsmail.com

Received 29 April 2019; Revised 29 May 2019; Editorial Decision 20 June 2019; Accepted 15 July 2019

Abstract

Aim: The aim of this randomized controlled trial was to examine the impact of daily supportive text messages over a 6-month treatment period on mood and alcohol consumption in individuals with a dual diagnosis of alcohol use disorder (AUD) and depression following completion of an inpatient treatment programme.

Method: Ninety-five adult participants with AUD and comorbid depression were recruited into this randomized control trial, which took place after completing a 30-day rehabilitation programme. The intervention group (n = 47) received twice-daily supportive text messages over 6-months while control participants (n = 48) had treatment as usual for a 6-month period, with an added 6-month post-treatment follow-up for both groups. Drinking history in the previous 90 days as well as symptoms of depression, anxiety and stress were measured at baseline, 3- and 6-month treatment points and 6-month post treatment follow up.

Results: Depression scores (P = 0.02) and perceived stress scores (P < 0.01) were significantly reduced at 3-month treatment point in the intervention group relative to control participants with small to medium effect. The intervention group also showed a significantly greater reduction in units per drinking day from baseline to 6-month treatment point compared to the control group with a medium effect size (P = 0.03). There were no differences in drinking or mood measures at 6-month post treatment follow-up.

Conclusions: Supportive text messages provide an early initial benefit in decreasing symptoms of depression and stress, with a further positive impact on alcohol consumption following a longer treatment period. Benefits did not persist six months after the intervention ended.

INTRODUCTION

The significant association between depression and alcohol use disorder (AUD) is well documented (Hasin *et al.*, 2007; Grant *et al.*, 2015; Lai *et al.*, 2015), with one study reporting a prevalence of lifetime depression in individuals with AUD at 35% (Mericle *et al.*, 2012). Individuals with this comorbidity are more disabled and demonstrate less treatment gains than individuals with AUD alone (Burns *et al.*, 2005). Additionally, this dual diagnosis is associated

with a greater relapse risk (Greenfield *et al.*, 1998; Driessen *et al.* 2001). Maintaining early abstinence post treatment is vital as this predicts later abstinence in these comorbid patients (Farren *et al.*, 2014), with abstinence at 6-months predicting abstinence at 2 years (Farren *et al.*, 2013). These studies highlight the importance of support in the initial 6-month period following treatment and need for novel outpatient intervention approaches for this difficult to treat comorbid population.

Interventions delivered via mobile phone technology for a variety of psychological and health conditions have found this to be an effective treatment platform (Heron & Smyth, 2010; Watson *et al.*, 2016). Specifically, research has highlighted the utility of text message support as a psychological intervention for smoking cessation (Rodgers *et al.*, 2005; Abroms *et al.*, 2014), depression (Agyapong *et al.*, 2017), anxiety (Whitton *et al.*, 2015), heavy/hazardous drinking in young adults (Haug *et al.*, 2013; Suffoletto *et al.*, 2014; Bock *et al.*, 2016) and AUD (Agyapong *et al.*, 2018). Furthermore, supportive text messages are simple, low cost, easy to implement and perceived positively by recipients (Agyapong *et al.*, 2016). We previously conducted a pilot trial investigating the efficacy of supportive text messages for post-treatment individuals with a dual diagnosis of depression and AUD, which found mood benefits following a 3-month intervention period as well as a trend for greater abstinence (Agyapong *et al.*, 2012).

Following on from our pilot trial, the aim of the present study was to complete a definitive randomized controlled trial to examine the effectiveness of supportive text messages on the recovery of individuals with a dual diagnosis of AUD and depression. Using a larger sample size, we wished to investigate treatment response to a 6-month intervention with a further 6-month follow-up to evaluate if short-term improvements previously documented are extendable to a longer time frame and to a broader range of outcomes. We expected scores on mood, anxiety and stress outcome measures, as well as number of drinking days and units of alcohol per drinking day, all to be lower at 3-month and 6-month treatment time points in the intervention group compared to the control group. We extended the evaluation to 12-months (6-month post treatment follow up) to ascertain if clinical effects extended beyond the 6-month intervention period.

METHODS

Design

An assessor-blinded parallel randomized controlled trial was performed, consisting of a baseline assessment with follow-up at 3- and 6-month treatment points and 6-months post-treatment. The study was approved by the St. Patrick's University Hospital Research Ethics Committee (protocol 13/14). The trial was registered with ClinicalTrials.gov (NCT02404662). Written informed consent was obtained from all participants. Recruitment into the study began in February 2015 until March 2018. The authors assert that all procedures contributing to this work comply with the ethical standards of the relevant national and institutional committees on human experimentation and with the Helsinki Declaration of 1975, as revised in 2008. This clinical trial is reported using the CONSORT criteria (Schulz *et al.*, 2010). See the trial protocol (Hartnett *et al.*, 2017) for full details of trial design and procedures. The only deviation from the trial protocol was in one outcome variable. In the protocol it stated 'cumulative abstinence duration' would be calculated at each follow-up period; however, here we report the opposite—'number of drinking days'.

Recruitment

Participants were recruited from St. Patrick's University Hospital, Dublin. Participants were inpatients completing the dual diagnosis or alcohol and chemical dependency therapeutic programme. See Farren & Mc Elroy (2008) for programme details.

Patients had to meet the following inclusion criteria to participate in the study: 1. Aged 18–70 years; 2. A score >25 on the Mini-Mental State Examination; 3. Completed their inpatient programme; 4. Met the criteria for both current major depressive episode and alcohol dependence on the Structured Clinical Interview for DSM-IV Axis I Disorders at baseline (SCID; First *et al.*, 1996); 5. A score of ≥14 on the Beck Depression Inventory at baseline; 6. Were in possession of a mobile phone.

Patients with an anxiety disorder or bipolar disorder were eligible for inclusion providing the above criteria were met. Alcohol had to be the primary substance of abuse in patients with polysubstance abuse. Patients with other psychiatric conditions, such as psychosis, were excluded.

Participants

One hundred and seventy-four inpatients were approached to participate in the study as they were deemed eligible from review of hospital charts or discussion at the multi-disciplinary team meetings. Of these, 38 declined participation when approached about the study. A further 41 were excluded following baseline assessment as they did not meet the inclusion criteria ($n = 29$), were lost to follow-up ($n = 10$), or had an incomplete baseline data set ($n = 2$). The 10 participants lost to follow-up matched the trial participants ($n = 95$) on all baseline variables except for average units of alcohol per drinking day, with the dropouts consuming significantly more than the trial participants at baseline. See Supplemental Data Table S1.

Ninety-five participants were included in the final trial numbers and completed at least one of the follow-up assessments. Participants were randomized to either the control condition ($N = 48$) or intervention group ($N = 47$) (See Fig. 1).

Procedure

Baseline assessment

Participants who volunteered to partake in the study were assessed by a member of the research team during the first two weeks of their inpatient stay. A medical and psychiatric history was obtained and the following measures/questionnaires completed.

The Modified Global Assessment of Functioning- Revised (m-GAF-R; Hall, 1995) was completed by the researcher to determine the participant's current level of social, occupational and psychological functioning (score range 0–90). All participants then completed the Mini Mental State Examination (MMSE; Folstein *et al.*, 1975) to examine current cognitive functioning (score range 0–30). The SCID (First *et al.*, 1996) was administered to confirm all participants met the criteria for both current Major Depressive Episode and Alcohol Dependence. The Time-Line Follow-Back (TLFB; Sobell & Sobell, 1992) was used to record the participants' alcohol use over the three months prior to their current hospital admission. Number of drinking days and average number of alcohol units consumed per drinking day over the preceding 3-month period were recorded.

Participants were then asked to complete various self-report questionnaires. Mood related problems were investigated through completion of the Beck Depression Inventory-II (BDI-II; score range 0–63; Beck *et al.*, 1961),the Beck Anxiety Inventory (BAI; score

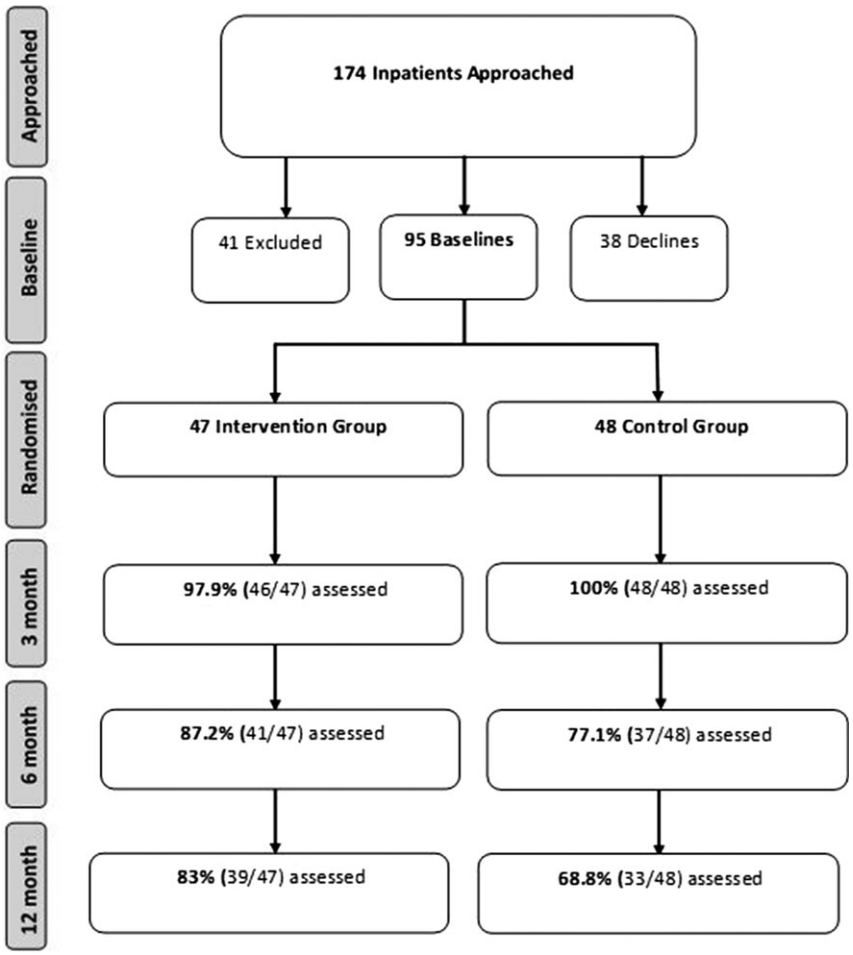

Fig. 1. Flow of study participants

range 0–63; Beck *et al.*, 1988) and the Perceived Stress Scale (PSS; Cohen *et al.*, 1983), assessing the extent to which life situations are viewed as stressful (score range 0–40). Higher scores on each of the three measures indicate a greater number of symptoms associated with depression, anxiety and stress.

Obsessive thoughts and compulsive behaviours related to drinking were examined using the Obsessive Compulsive Drinking Scale (OCDS; Anton *et al.*, 1995). This measure produces a total score (score range 0–40) and two subscale scores—obsessive and compulsive subscales (score range 0–20). Higher scores indicate greater obsessive thoughts and compulsive behaviours.

Randomization and intervention

Following baseline assessment, the participants were informed that upon discharge they would be randomly assigned to either the intervention group in addition to treatment as usual (TAU) or the control condition consisting of TAU only. TAU for both groups consisted of optional stepdown/ aftercare, psychiatric follow-up and/or self-help support groups. Assignment to group was completed using a random number generator by the research fellow who was unblinded to group allocation but had no further involvement in assessing participants at follow-up. Additionally, participants were requested not to reveal their group assignment at the follow-up assessments.

Upon discharge, participants assigned to the intervention group received twice-daily text messages (10am & 7 pm) for 6 months. The message content focused on mood and alcohol abstinence and were delivered using an automated system (See Hartnett *et al.*, 2017 & Agyapong *et al.*, 2012 for further details). Participants in both groups received a fortnightly text message thanking them for participating in the research study. In addition, the research fellow rang each participant every fortnight to check that they were not experiencing any technical difficulties with the message delivery.

Primary and secondary outcomes

The primary alcohol outcomes were changed in units per drinking day and number of drinking days in the previous 90 days. The primary mood outcome was changed in BDI score at each follow-up point. Secondary outcomes included the proportion of patients continuously abstinent from alcohol, time to first drink following discharge, and changes in BAI, PSS and OCDS scores at each follow-up time point.

Follow-up assessments

Follow-up assessments were completed at 3- and 6-month treatment points and 6 month post-treatment. Assessments were completed face to face, over the phone or via post. The assessment procedure involved updating personal and medical information, recording

aftercare/outpatient or self-help attendance and alcohol usage for the previous 3 months. Alcohol usage was calculated using the TLFB (Sobell & Sobell, 1992). The BDI-II (Beck *et al.*, 1961), BAI (Beck *et al.*, 1988), PSS (Cohen *et al.*, 1983) and OCDS (Anton *et al.*, 1995) were completed by participants at each assessment time point.

Statistical analysis

Data were analysed using IBM SPSS Statistics version 22 for Windows (IBM Corp. Armonk, NY). Independent samples *t*-test, Mann–Whitney *U*, and Chi Square analyses were used to examine differences between groups on baseline clinical and demographic factors. With the exception of the Perceived Stress Scale, the follow-up data for all outcome variables had non-normal distributions and so non-parametric statistics (Mann–Whitney *U* Tests) were used to examine change over time. Change scores were calculated by subtracting the follow-up data value from the baseline data value for each participant at each time point. For the PSS a Mixed Design ANOVA model was used to compare differences between groups across time on the PSS at 3- and 6-month treatment time point, and 6-month post treatment follow up, with time (Baseline vs. X-month follow-up period) as the repeated measure variable and Group (Intervention vs. Control) as the between subjects variable. Main effects and interaction effects are reported. Effect sizes were reported as correlation coefficient *r* (Small = 0.1, Medium = 0.3, Large = 0.5) or partial eta squared (Small = 0.01, Medium = 0.09, Large = 0.25) for continuous data and Cramer's V for categorical data (Small = 0.1, Medium = 0.3, Large = 0.5). It was estimated that a sample size of 62 per group would be required for alpha level of 0.05 and power of 0.8 (Hartnett *et al.*, 2017).

RESULTS

Participant characteristics

There was no significant difference between groups across demographic or baseline clinical characteristics (see Table 1). No difference was seen between groups in the numbers that attended outpatient treatment such as Stepdown/Aftercare or self-help support groups such as Alcoholics Anonymous or LifeRing post discharge at 3- or 6-month treatment time points or 6-month post-treatment follow-up (3 months: Aftercare (Chi Sq (1) = 1.82, $P = 0.22$), Self-help (Chi Sq (1) = 0.444, $P = 0.61$); 6 months: Aftercare (Chi Sq (1) = 1.79, $P = 0.25$), Self-help (Chi Sq (1) = 0.751, $P = 0.41$); 6-month post-treatment follow-up: Aftercare (Chi Sq (1) = 1.03, $P = 0.34$), Self-help (Chi Sq (1) = 0.195, $P = 0.79$). A loss to follow-up analysis suggested that participants were missing at random as their baseline scores did not differ significantly from those participants who completed the follow-up assessments (See Supplementary Table S2). Thus, pairwise deletion rather than data imputation was used to handle missing data. 65.3% of participants completed all follow-up assessments (56.3% of the control group vs 74.5% of the intervention group). In terms of retention, 99% completed the 3-month treatment time point, 82% the 6-month treatment time point, and 76% completed the 6-month post-treatment follow-up, with a greater loss to follow-up in the control group compared to the intervention group at 6 months treatment and 6 months post treatment follow up.

Drinking outcomes at 3-month treatment time point

About 35% of the intervention group and 43% of the control group had consumed alcohol since discharge from hospital (Chi Sq (1) = 0.592, $P = 0.53$, Cramer's $V = 0.08$). For those participants who consumed alcohol there was no significant difference between groups in the number of days to first drink ($U = 148$, $P = 0.71$, $r = 0.06$). Between baseline and 3-month treatment time point there was no significant difference between groups in change scores for number of drinking days ($U = 903.5$, $P = 0.38$, $r = 0.1$) or average units of alcohol per drinking day (U = 897, $P = 0.35$, $r = 0.1$). See Table 2 for change scores and Supplementary Table S3 for group means/medians.

Mood outcomes at 3-month treatment time point

The intervention group showed a significantly greater reduction in BDI scores from baseline to the 3-month treatment time point compared to the control participants ($U = 704$, $P = 0.02$, $r = 0.3$). For the PSS measure a significant main effect for time was found with PSS scores lowering significantly for all participants from baseline to the 3-month treatment time point ($F(1,85) = 128.8$, $P < 0.01$, *partial* $\eta^2 = 0.6$). There was also a significant interaction effect between group and time ($F(1,85) = 3.9$, $P = 0.05$, *partial* $\eta^2 = 0.04$), with the intervention group have significantly lower PSS scores at the 3-month treatment time point compared to controls.

No significant difference was found between groups in change scores from baseline to 3-month treatment time point on the BAI ($U = 899$, $P = 0.46$, $r = 0.08$), OCDS total ($U = 900.5$, $P = 0.85$, $r = 0.1$), OCDS Obsessive subscale ($U = 826.5$, $P = 0.41$, $r = 0.1$) or OCDS Compulsive subscale ($U = 917.5$, $P = 0.96$, $r = 0.01$).

Drinking outcomes at 6-month treatment time point

A smaller proportion of the intervention group (56%), compared to the control group (67%) had consumed alcohol since discharge from hospital, however this difference was not significant (Chi Sq (1) = 1.3, $P = 0.28$, Cramer's $V = 0.12$). Groups differed significantly in average units of alcohol per drinking day change score ($U = 494$, $P = 0.03$, $r = -0.3$) with the intervention group showing a greater reduction in alcohol consumption in comparison to control participants from baseline. For those participants who consumed alcohol over the previous 6 months, there was no significant difference between groups in the number of days to first drink ($U = 341$, $P = 0.88$, $r = 0.02$) or in the number of drinking days change score ($U = 694$, $P = 0.65$, $r = 0.05$).

Mood outcomes at 6-month treatment time point

No significant difference was found between groups in change scores on the BDI-II ($U = 528$, $P = 0.13$, $r = 0.2$) or BAI questionnaire ($U = 545.5$, $P = 0.19$, $r = 0.15$). A significant main effect of time was found for PSS scores ($F(1,71) = 71.6$, $P < 0.01$, *partial* $\eta^2 = 0.5$) on the mixed design ANOVA, with scores lowering significantly for all participants from baseline to 6-month treatment time point. No interaction effect between group and time was found however.

No significant difference was found between groups in change scores from baseline to 6-month treatment time point on OCDS total score ($U = 602$, $P = 0.78$, $r = 0.03$), OCDS Obsessive subscale ($U = 577$, $P = 0.57$, $r = 0.1$) or OCDS Compulsive subscale ($U = 518.5$, $P = 0.21$, $r = 0.2$).

Drinking outcomes at 6 month post treatment follow-up

Seventy-one percent of the intervention group and 71% of the control group had consumed alcohol at some point in the past 12 months. For those participants who consumed alcohol over the previous 12 months, there was no significant difference between groups in the number of days to first drink ($U = 321$, $P = 0.25$, $r = 0.2$). There was no significant difference between groups in number of drinking

Table 1. Baseline demographic and clinical characteristics of participants

Variable	Intervention	Control	95% CI of Difference	*P**
N	47	48	-	-
Male gender				
n (%)	24 (51.1%)	20 (41.7%)	-	0.36
Age years				
Mean (SD)	49.5 (10.4)	46.6 (10.6)	−1.4 – 7.2	0.18
Education years,	(*N* = 47)	(*N* = 47)		
mean (SD)	15.4 (3.2)	16 (2.4)	−1.7 – 0.6	0.34
Employed[$],	(*N* = 46)	(*N* = 48)		
n (%)	37 (80.4%)	39 (81.3%)	-	0.92
Single				
n (%)	13 (27.7%)	15 (31.3%)	-	0.82
M-GAF score,				
Median (range)	48 (0–58)	48 (0–58)	-	0.73
Mean (SD)	45.8 (9)	44.2 (11.2)	-	-
Drinking days in past 3 months,	(*N* = 47)	(*N* = 47)		
Median (range)	79 (6–90)	65 (4–90)	-	0.26
Mean (SD)	63.1 (29.4)	59.2 (28.5)	-	-
Average units of alcohol per drinking day,	(*N* = 46)	(*N* = 47)		
Median (range)	16.2 (4–36)	13.6 (6–32)	-	0.15
Mean (SD)	16.5 (7.7)	14.1 (5)	-	-
BDI-II Score				
Median (range)	28 (14–59)	27.5 (14–53)	-	-
Mean (SD)	31 (12)	29.9 (10.8)	−3.6 – 5.8	0.64
BAI Score				
Median (range)	26 (5–61)	25.5 (0–56)	−6.4 – 5.5	0.87
Mean (SD)	27.2 (14.5)	27.6 (14.6)		
PSS Score				
Median (range)	28 (11–39)	27 (4–39)	-	-
Mean (SD)	27.6 (6.3)	26.6 (6.5)	−1.6 – 3.6	0.45
OCDS total score,				
Median (range)	11 (0–27)	8 (0–40)	-	0.50
Mean (SD)	11.3 (8.4)	10.6 (8.9)	-	-
Obsessive subscale				
Median	6 (0–14)	5 (0–20)	-	0.93
Mean (SD)	5.1 (4.2)	5.2 (4.4)	-	-
Compulsive subscale				
Median	5 (0–18)	5 (0–20)	-	0.37
Mean (SD)	6.2 (5.1)	5.3 (5.3)	-	-

*Independent *t*-test or Mann–Whitney *U* test used for continuous data. Chi Square test for categorical data.

[$]Employed = paid employment, retired, student or caring for family.

M-GAF = Modified Global Assessment of Functioning; BDI-II = Beck Depression Inventory; BAI = Beck Anxiety Inventory; PSS = Perceived Stress Scale; OCDS = Obsessive Compulsive Drinking Scale.

days change score (U = 551, $P = 0.4$, $r = 0.1$) or average units per drinking day change score (U = 528, $P = 0.47$, $r = 0.1$). However, both groups showed a significant reduction in the number of drinking days (Intervention: $Z = -5.31$, $P < 0.001$; Control: $Z = -4.69$, $P < 0.001$) and units per drinking day (Intervention: $Z = -4.46$, $P < 0.001$; Control: $Z = -4.06$, $P < 0.001$) between baseline and 6-month post treatment follow-up.

Mood outcomes at 6-month post treatment follow-up

No significant difference was found between groups in change scores on the BDI-II ($U = 502.5$, $P = 0.23$, $r = 0.14$) or BAI questionnaire ($U = 483.5$, $P = 0.43$, $r = 0.1$). The results of the mixed ANOVA found a significant main effect of time was found for PSS scores ($F(1,63) = 68$, $P < 0.01$, *partial* $\eta^2 = 0.52$), with scores lowering significantly for all participants from baseline to 6-month post-treatment follow-up. No interaction effect was found between group and time on this measure. No significant difference was found between groups in change scores from baseline to 6-month post treatment follow-up on OCDS total (U = 500, $P = 0.68$, $r = 0.05$), OCDS Obsessive subscale ($U = 450.5$, $P = 0.73$, $r = 0.04$) or OCDS Compulsive subscale ($U = 479.5$, $P = 0.50$, $r = 0.1$). Both groups did show a significant reduction in BDI-II scores (Intervention: $Z = -5.12$, $P < 0.001$; Control: $Z = -3.81$, $P < 0.001$) BAI scores (Intervention: $Z = -4.80$, $P < 0.001$; Control: $Z = -3.89$, $P < 0.001$) and PSS scores (Intervention: $Z = -4.65$, $P < 0.001$; Control: $Z = -3.75$, $P < 0.001$) between baseline and 6-month post treatment follow-up.

DISCUSSION

This randomized controlled trial has demonstrated that supportive text messages for individuals with a dual diagnosis of AUD and depression can have a positive impact on mood and lower alcohol

Table 2. Change scores in alcohol and mood outcomes at 3, 6 & 12 month follow-ups

Outcome variables	3-month follow-up		6-month follow-up		12-month follow-up	
	Intervention	Control	Intervention	Control	Intervention	Control
Drinking days in past 3 months	(*N* = 45)	(*N* = 45)	(*N* = 41)	(*N* = 36)	(*N* = 39)	(*N* = 32)
Median	72	60	56	58.5	48	56.5
Mean (SD)	59.7 (29.3)	55.5 (27.7)	54.1 (32.1)	52 (31.2)	52.9 (32.2)	48.3 (33.1)
Average units of alcohol per drinking day	(*N* = 45)	(*N* = 45)	(*N* = 39)	(*N* = 36)	(*N* = 38)	(*N* = 31)
Median	11.2	10.2	12	9.2	10.3	9.7
Mean (SD)	12 (10.0)	9.2 (7.9)	*12.4 (8.6)	8.0 (7.9)	10.8 (11.3)	8.4 (7.7)
BDI-II Score	(*N* = 45)	(*N* = 44)	(*N* = 38)	(*N* = 35)	(*N* = 39)	(*N* = 31)
Median	20	11	16	11	20	13
Mean (SD)	*19.8 (12.3)	13 (15.1)	16.2 (13.8)	13 (14.8)	18.9 (13.8)	14 (15.4)
BAI Score	(*N* = 45)	(*N* = 44)	(*N* = 38)	(*N* = 35)	(*N* = 39)	(*N* = 28)
Median	12	9.5	13.5	13	17	14.5
Mean (SD)	13.8 (13.1)	11.5 (16)	17 (13)	12.2 (13.8)	16.8 (15.2)	13.8 (13.7)
PSS Score	(*N* = 45)	(*N* = 42)	(*N* = 38)	(*N* = 35)	(*N* = 37)	(*N* = 28)
Median	10	6	10	8	9	10
Mean (SD)	*11.4 (7.5)	8.0 (8.4)	9.3 (8.8)	8.5 (9.2)	10.2 (9.3)	10.3 (10.7)
OCDS Total score	(*N* = 45)	(*N* = 41)	(*N* = 38)	(*N* = 33)	(*N* = 38)	(*N* = 28)
Median	2	2	2.5	4	2	4
Mean (SD)	2.7 (8.5)	3.8 (10.4)	4.4 (7.6)	3.6 (10.2)	4.2 (9.4)	3.2 (13.4)
OCDS Obsessive subscale	(*N* = 45)	(*N* = 41)	(*N* = 38)	(*N* = 33)	(*N* = 38)	(*N* = 25)
Median	1	2	1	2	1	3
Mean (SD)	0.9 (4.2)	1.9 (4.5)	1.6 (3.9)	2.4 (4.6)	1.7 (4.3)	2.2 (6)
OCDS Compulsive subscale	(*N* = 45)	(*N* = 41)	(*N* = 38)	(*N* = 33)	(*N* = 38)	(*N* = 28)
Median	1	2	2	0	2	0.5
Mean (SD)	1.7 (5.1)	1.9 (6.8)	2.7 (5)	1.1 (6.9)	1.9 (5.9)	0.3 (9.8)

*$P < 0.05$.

consumption post-discharge from an alcohol treatment programme. Results of the trial highlighted clinically significant benefits in mood at the 3-month treatment time point, with the intervention group showing a significantly greater reduction from baseline in symptoms of depression and perceived stress in comparison to control participants, with small to medium effect sizes. This benefit, however, did not extend to the 6-month treatment time point, suggesting that the supportive text messages had greatest efficacy in the initial few months post-discharge. Differences also emerged in alcohol outcome measures, again with the intervention group displaying a significant decrease in units of alcohol consumed per drinking day from baseline to 6-month treatment time point, compared to the control group. Furthermore, in comparison to the control group a smaller percentage of participants in the intervention group had consumed alcohol during the active intervention period as measured at 3- and 6-month treatment time points; however, this difference was not significant. A further follow-up at 6-months post treatment, found no between group differences in mood or alcohol outcomes.

The 3-month treatment finding of reduced symptoms of depression supports the results of our previous pilot trial in a smaller population (Agyapong *et al.*, 2012). A recent study by Agyapong and colleagues (2017) evaluating the efficacy of supportive text messages for individuals with depression over a 3-month intervention period also found symptoms significantly reduced. The 3-month period post inpatient treatment is crucial in the recovery outcomes of individuals with a dual diagnosis, with early abstinence predicting later abstinence (Farren *et al.*, 2014). The results of the current trial may signify that mood effects at 3-months could be an influencing factor for differences in alcohol consumption noted at 6-months. Group differences in symptoms of depression were not seen at the 6-month treatment time point. This may be due to acclimatization to text messaging support. Although the text messages were varied throughout the 6-month intervention, the messages may have had less of an emotional impact by then.

A further finding in the current trial was a significant reduction in perceived stress between baseline and the 3-month treatment time point for the intervention group only. Perceived stress is strongly associated with depression (Hewitt *et al.*, 1992), low mental health quality of life (Mitchell *et al.*, 2008) and low levels of life satisfaction (Lee *et al.*, 2016). The same effect was not noted for symptoms of anxiety. Previous research by Whitton *et al.* (2015), investigating the effectiveness of a mobile phone and web-based self-help programme, reported a significant reduction in symptoms of anxiety, which was associated with the use of the motivational text message component of this programme. These messages were also the most commonly used component. The lack of intervention effect on anxiety outcomes in our study may be because the supportive messages specifically focused on promoting positive mood as opposed to anxiety management. Future studies could examine whether a combination of mood and anxiety supportive messages could extend the intervention effects to help reduce anxiety also.

The beneficial intervention effect on alcohol consumption took longer to emerge, with a significant reduction in units of alcohol per drinking day at the 6-month treatment time point. This suggests that a text message intervention may be helpful in reducing binge or heavy drinking, an important factor in the negative health consequences of alcohol consumption (Greenfield *et al.*, 2000). This also suggests that repetition of a recovery-oriented message may not produce intervention fatigue, and it could be an important longer-term intervention tool. In line with our results, previous research in both an AUD and dual diagnosis samples did not find a significant 3-month intervention effect on alcohol outcomes (Agyapong *et al.* 2012,

2018), but this is the first study examining a longer intervention period. Research by Haug *et al.* (2013) did demonstrate a significant decrease in alcohol consumption following a 3-month intervention for adolescents with risky drinking behaviours; however, their study incorporated individualized messages. It is possible that personalization of the text messages, perhaps by demographics or severity of disorder, could have achieved an addiction benefit at 3-months, or a mood benefit that would be sustained over 6- months. Personalization was not possible in the current trial as it would have meant a more complex and costly intervention to develop but given previous findings, it may be worth exploring.

The benefits of mobile phone-based interventions relative to other forms of intervention include the immediacy of access, regardless of geographic location, as well as cost-effectiveness of providing support simultaneously to a large number of treatment-seeking individuals. Frequency of engagement can also be determined by the end user to meet their individual needs. Additionally, text message support is generally positively received by recipients. Participants in one study reported that the messages improved their self-efficacy in terms of symptom management and provided a sense of connectedness (Agyapong *et al.*, 2016). Mobile phone interventions also have the potential to provide treatment to individuals who may decline more traditional forms of psychological intervention, perhaps due to issues such as perceived stigma surrounding mental health conditions. These benefits highlight the development potential of mobile phone-based interventions and future areas of possible mental health research.

Limitations of the study include the post-rehabilitation population; participants had already demonstrated an eagerness to engage in treatment, and the findings may not generalize to non-treatment engaged populations. The study setting was an independent sector psychiatric hospital; thus, the socio-economic status of participants could be an additional factor in the receptiveness to this style of intervention, and this factor would need to be addressed in future studies. Furthermore, all subjects in both arms of the study received a significant amount of clinical input during their rehabilitation, and TAU post-discharge involved optional aftercare groups, self-help meetings and ongoing psychiatric follow-up. TAU here may itself be greater than standard rehabilitation follow-up elsewhere. Indeed, clinical outcomes in both groups were very good, with a significant reduction in mood problems and alcohol consumption from baseline to 6-month post-treatment follow-up for both groups. Thus, any added intervention would need to be highly effective to produce added clinically detectible benefit. This suggests that this intervention should be considered in other groups or settings, such as dual disordered patients prior to entry into rehabilitation, or dual disordered patients that are unable or unwilling to enter a rehabilitation programme.

This limitation, however, makes the positive findings of the study more impressive given the post-rehabilitation setting. Additionally, it is important to note the inclusion of participants with anxiety and bipolar diagnoses. All participants met the criteria for current major depressive episode and alcohol dependence (SCID; First *et al.*, 1996), however given the high prevalence between AUD and other psychiatric conditions, particularly anxiety and bipolar disorders (Hasin *et al.*, 2007; Grant *et al.*, 2015; Lai *et al.*, 2015), it was necessary to permit inclusion of these diagnoses for recruitment purposes A final limitation was the sample size, a smaller sample ($n = 95$) was recruited than that originally estimated ($n = 126$) to ensure adequate power (Hartnett *et al.*, 2017), as a result we cannot rule out the possibility of Type II error in our findings.

In conclusion, the current study adds further evidence to the growing body of research demonstrating the efficacy of supportive text messages as a psychological intervention. These findings suggest that text messages can provide post-treatment support to individuals with a dual diagnosis of AUD and depression at a crucial time in their recovery. Overall, the results of this trial showed an initial benefit for mood support which faded over the extended intervention period while, the positive impact on alcohol consumption took longer to emerge, and these benefits did not persist after cessation of text messages.

SUPPLEMENTARY MATERIAL

Supplementary data are available at *Alcohol And Alcoholism* online.

ACKNOWLEDGEMENTS

The authors wish to thank all of our patients for their participation in this study.

CONFLICT OF INTEREST STATEMENT

Declan M McLoughlin has received a speaker's honorarium from the ECT device manufacturer Mecta and an honorarium from Janssen for participating in an esketamine advisory board meeting.

FINANCIAL SUPPORT

This study was funded by Health Research Board HRB- POR- 2014-598.

REFERENCES

Abroms LC, Boal AL, Simmens SJ, *et al.* (2014) A randomized trial of Text2Quit: a text messaging program for smoking cessation. *Am J Prev Med* **47**:242–50.

Agyapong VI, Ahern S, McLoughlin DM, *et al.* (2012) Supportive text messaging for depression and comorbid alcohol use disorder: single-blind randomised trial. *J Affect Disord* **141**:168–76.

Agyapong VI, Juhás M, Mrklas K, *et al.* (2018) Randomized controlled pilot trial of supportive text messaging for alcohol use disorder patients. *J Subst Abuse Treat* **94**:74–80.

Agyapong VI, Juhás M, Ohinmaa A, *et al.* (2017) Randomized controlled pilot trial of supportive text messages for patients with depression. *BMC Psychiatry* **17**:286.

Agyapong VI, Mrklas K, Juhás M, *et al.* (2016) Cross-sectional survey evaluating Text4Mood: mobile health program to reduce psychological treatment gap in mental healthcare in Alberta through daily supportive text messages. *BMC Psychiatry* **16**:378.

Anton RF, Moak DH, Latham P. (1995) The Obsessive Compulsive Drinking Scale: a self-rated instrument for the quantification of thoughts about alcohol and drinking behavior. *Alcohol Clin Exp Res* **19**:92–9.

Beck AT, Epstein N, Brown G, *et al.* (1988) An inventory for measuring clinical anxiety: psychometric properties. *J Consult Clin Psychol* **56**:893.

Beck AT, Ward CH, Mendelson M, *et al.* (1961) An inventory for measuring depression. *Arch Gen Psychiatry* **4**:561–71.

Bock BC, Barnett NP, Thind H, *et al.* (2016) A text message intervention for alcohol risk reduction among community college students: TMAP. *Addict Behav* **63**:107–13.

Burns L, Teesson M, O'Neill K. (2005) The impact of comorbid anxiety and depression on alcohol treatment outcomes. *Addiction* **100**:787–96.

Cohen S, Kamarck T, Mermelstein R. (1983) A global measure of perceived stress. *J Health Soc Behav* **24**:385–96.

Driessen M, Meier S, Hill A, *et al.* (2001) The course of anxiety, depression and drinking behaviors after completed detoxification in alcoholics with and without comorbid anxiety and depressive disorders. *Alcohol Alcohol* **36**:249–55.

Farren CK, Mc Elroy S. (2008) Treatment response of bipolar and unipolar alcoholics to an inpatient dual diagnosis program. *J Affect Disord* **106**: 265–72.

Farren CK, Murphy P, McElroy S. (2014) A 5-Year Follow-Up of Depressed and Bipolar Patients with Alcohol Use Disorder in an Irish Population. *Alcohol Clin Exp Res* **38**:1049–58.

Farren CK, Snee L, Daly P, *et al.* (2013) Prognostic factors in 2-year outcomes of patients with comorbid bipolar disorder or depression with alcohol dependence: importance of early abstinence. *Alcohol Alcohol* **48**:93–8.

First MB, Gibbon M, Spitzer RL, *et al.* (1996) *User's Guide for the Structured Clinical Interview for DSM-IV Axis I Disorders—Research Version*. New York: Biometrics Research Department, New York State Psychiatric Institute.

Folstein MF, Folstein SE, McHugh PR. (1975) 'Mini-mental state': a practical method for grading the cognitive state of patients for the clinician. *J Psychiatr Res* **12**:189–98.

Grant BF, Goldstein RB, Saha TD, *et al.* (2015) Epidemiology of DSM-5 alcohol use disorder: results from the National Epidemiologic Survey on Alcohol and Related Conditions III. *JAMA. Psychiatry* **72**:757–66.

Greenfield TK, Midanik LT, Rogers JD. (2000) A 10-year national trend study of alcohol consumption, 1984–1995: is the period of declining drinking over? *Am J Public Health* **90**:47.

Greenfield SF, Weiss RD, Muenz LR, *et al.* (1998) The effect of depression on return to drinking: a prospective study. *Arch Gen Psychiatry* **55**:259–65.

Hall RC. (1995) Global assessment of functioning: a modified scale. *Psychosomatics* **36**:267–75.

Hartnett D, Murphy E, Kehoe E, *et al.* (2017) Supportive text messages for patients with alcohol use disorder and a comorbid depression: a protocol for a single-blind randomised controlled aftercare trial. *BMJ Open* **7**: e013587.

Hasin DS, Stinson FS, Ogburn E, *et al.* (2007) Prevalence, correlates, disability, and comorbidity of DSM-IV alcohol abuse and dependence in the United States: results from the National Epidemiologic Survey on Alcohol and Related Conditions. *Arch Gen Psychiatry* **64**:830–42.

Haug S, Schaub MP, Venzin V, *et al.* (2013) A pre-post study on the appropriateness and effectiveness of a Web-and text messaging-based intervention to reduce problem drinking in emerging adults. *J Med Internet Res* **15**:e196.

Heron KE, Smyth JM. (2010) Ecological momentary interventions: incorporating mobile technology into psychosocial and health behaviour treatments. *Br J Health Psychol* **15**:1–39.

Hewitt PL, Flett GL, Mosher SW. (1992) The Perceived Stress Scale: factor structure and relation to depression symptoms in a psychiatric sample. *J Psychopathol Behav Assess* **14**:247–57.

Lai HMX, Cleary M, Sitharthan T, *et al.* (2015) Prevalence of comorbid substance use, anxiety and mood disorders in epidemiological surveys, 1990–2014: a systematic review and meta-analysis. *Drug Alcohol Depend* **154**:1–13.

Lee J, Kim E, Wachholtz A. (2016) The effect of perceived stress on life satisfaction: The mediating effect of self-efficacy. *Ch'ongsonyonhak yongu* **23**: 29.

Mericle AA, Ta Park VM, Holck P, *et al.* (2012) Prevalence, patterns, and correlates of co-occurring substance use and mental disorders in the United States: variations by race/ethnicity. *Compr Psychiatry* **53**:657–65.

Mitchell AM, Crane PA, Kim Y. (2008) Perceived stress in survivors of suicide: psychometric properties of the Perceived Stress Scale. *Res Nurs Health* **31**:576–85.

Rodgers A, Corbett T, Bramley D, *et al.* (2005) Do u smoke after txt? Results of a randomised trial of smoking cessation using mobile phone text messaging. *Tob Control* **14**:255–61.

Schulz KF, Altman DG, Moher D, for the CONSORT Group. (2010) CONSORT 2010 Statement: updated guidelines for reporting parallel group randomised trials. *J Clin Epidemiol* **63**:834–40.

Sobell LC, Sobell MB. (1992) Timeline follow-back. In: Litten RZ, Allen JP (eds). *Measuring Alcohol Consumption*. Totowa, NJ: Humana Press, 41–72.

Suffoletto B, Kristan J, Callaway C, *et al.* (2014) A text message alcohol intervention for young adult emergency department patients: a randomized clinical trial. *Ann Emerg Med* **64**:664–72.

Watson T, Simpson S, Hughes C. (2016) Text messaging interventions for individuals with mental health disorders including substance use: a systematic review. *Psychiatry Res* **243**:255–62.

Whitton AE, Proudfoot J, Clarke J, *et al.* (2015) Breaking open the black box: isolating the most potent features of a web and mobile phone-based intervention for depression, anxiety, and stress. *JMIR Ment Health* **2**:e3.