Efficacy of a minimally guided internet treatment for alcohol misuse and emotional problems in young adults: Results of a randomized controlled trial

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ABSTRACT

Objective: Many young adults struggle with comorbid alcohol misuse and emotional problems (i.e., depression and anxiety). However, there is currently a paucity of evidence-based, integrated, accessible treatment options for individuals with these comorbidities. The main goal of this study was to examine efficacy of a novel online, minimally guided, integrated program for comorbid alcohol misuse and emotional problems in young adults. *Method:* The study was an open-label two-arm RCT. Participants ($N = 222$, $M_{age} = 24.6$, 67.6% female) were randomized to one of two conditions: the Take Care of Me program (an 8-week, online integrated treatment condition consisting of 12 modules), or an online psychoeducational control condition. Intervention modules incorporated content based on principles of cognitive behavioral therapy and motivational interviewing. Participants completed assessment data at baseline, at the end of treatment (i.e., 8 weeks), and at follow-up (i.e., 24 weeks). Data were analyzed using generalized linear mixed models. *Results:* We observed that participants in the treatment condition showed larger reductions in depression, hazardous drinking, as well as increases in psychological quality of life and confidence at the end of treatment. We did not find group differences on total alcohol use at follow-up, but participants in the treatment group reduced their hazardous drinking and improved their quality of life at 24-week follow-up. *Conclusions:* Our study provides promising initial evidence for the first iteration of the comorbid alcohol misuse and emotional problems online program.

1. Introduction

Alcohol misuse and emotional problems represent one of the most common mental health comorbidities in the general population (Castillo-Carniglia et al., 2019; Lai et al., 2015), with 50–60% of individuals with an alcohol use disorder also meeting criteria for depression and/or anxiety (Davis et al., 2008). Young adulthood, defined as ages 18–29 (Arnett et al., 2014), is a critical time to consider the co-occurrence of alcohol misuse and emotional problems. Individuals in this age group report the highest rates of hazardous drinking (e.g., misuse, alcohol-related problems; Whiteford et al., 2013) and emotional problems such as depression and anxiety (Ibrahim et al., 2013; Schry & White, 2013). Not surprisingly given the high comorbidity rates, these emotional challenges are likewise related to drinking problems among young adults (Grothues et al., 2008). The impact of both disorders leads to disproportionately greater impairment than either disorder alone, including poor health and treatment outcomes, higher rates of relapse, increased suicidality, relationship difficulties, increased risk of injury or accidents, and early mortality (Beidel et al., 2014; Grant et al., 2015; Lai et al., 2015; Prior et al., 2017). Furthermore, people with comorbid alcohol misuse and emotional problems place a burden on the healthcare system due to the complex treatment needs, frequent use of healthcare resources, compensation for disability, and involvement with the law (Whiteford et al., 2013; World Health Organization, 2014).

1.1. Treatment approaches

Many theories have been used in the addictions literature to explain the high co-occurrence of alcohol and emotional problems. In general, the literature supports reciprocal associations between emotional problems and alcohol misuse (Stewart et al., 2016), suggesting that these two mental health issues are interconnected. Despite this high comorbidity, limited studies have examined the effects of integrated treatment for both problems within a single intervention.

Most existing treatments for comorbid alcohol misuse and emotional problems utilize either sequential or parallel approaches (DeVido & Weiss 2012; Mueser et al., 2003). Sequential methods involve treating the disorder deemed more severe first, whereas in parallel treatment methods, individuals are treated for both alcohol misuse and emotional problems concurrently, but in different settings or by distinct professionals. Although parallel or sequential approaches to treatment may be suitable in certain situations (e.g., crisis situations, limited availability of services in a given area), both methods fail to acknowledge the complex interconnected nature of these issues. Unfortunately, without addressing both disorders concurrently, people often cannot experience marked improvements in either problem (Drake et al., 2007). Compared to traditional approaches, the goal of integrated treatment is to target symptoms of both alcohol misuse and emotional problems simultaneously within the same program and setting (Mueser et al., 2003), thus addressing limitations within sequential and parallel frameworks.

The existing literature would suggest that integrating cognitive behavioural therapy (CBT; Hofmann et al., 2012) and motivational interviewing (MI; Vasilaki et al., 2006) concurrently within a single intervention would be beneficial for addressing difficulties with both alcohol use and emotional symptomology (Riper et al., 2014; Morley et al., 2016; Westra et al., 2016). The goal of CBT is to help clients address maladaptive thinking patterns and behaviours that maintain feelings of depression and anxiety, as well as build helpful coping skills for managing stressors and triggers. CBT is a highly efficacious, recommended treatment for mood and anxiety disorders (Etzelmueller et al., 2020; Hofmann et al., 2012). MI is a collaborative treatment approach designed to reduce ambivalence or resistance and elicit motivation for change and is widely accepted and supported as treatment for alcohol use (Miller & Rollinck, 2013), resulting in moderate-to-large effect sizes compared to no treatment (Vasilaki et al., 2006). Previous research has demonstrated CBT may also be effective for treating substance use (Baker et al., 2012), and MI can reduce symptoms of depression and anxiety (Arkowitz & Burke, 2008), albeit with smaller effect sizes for each.

In light of the call for integrated treatment options, previous studies have demonstrated CBT and MI may be promising approaches when combined to address both alcohol misuse and emotional symptomology simultaneously (Riper et al., 2014). CBT requires engagement from the client (e.g., homework, environmental changes, activities, confronting stressors). Given that resistance to treatment is a common barrier among individuals struggling with substance use (Priester et al., 2016), MI stands to increase readiness for change (e.g., reducing or eliminating alcohol use), as well as improve treatment engagement with CBT-specific content. Furthermore, MI helps clients act in ways that are more closely aligned with their goals and values, which may likewise increase motivation for behavioural change. It follows logically that implementing both CBT and MI would yield promising results, as the two complement each other theoretically, and thus therapeutically (Iarussi, 2019).

Research examining the efficacy of integrated CBT and MI treatment for comorbid alcohol misuse and emotional has only emerged over the past several years. For example, a *meta*-analysis by Riper and colleagues (2014) found that integrated CBT and MI was effective at reducing symptoms of alcohol use and depression with small effect sizes compared to alternate treatments, and similar effect sizes were observed for subclinical populations. While these findings are promising, few studies to date have examined the efficacy of integrated CBT and MI for comorbid alcohol misuse and anxiety. Given the considerable overlap between anxious and depressive symptoms, it follows that interventions designed to manage emotional distress defined more broadly are both feasible and likely to yield beneficial results comparable to treatments that target alcohol use and depression exclusively.

1.2. Internet-Based treatment

Considerable effort and research are being placed into the development of new online interventions for addiction and mental health issues (Cunningham et al., 2020; Deady et al., 2016; Garrido et al., 2019). Previous research has demonstrated the efficacy of online treatment for depression (Buntrock et al., 2015; Karyotaki et al., 2017, 2021), anxiety (Andersson et al., 2019), and alcohol use (Hadjistavropoulos, Mehta, Wilhelms, Keough, & Sundström, 2020; Riper et al., 2018) in isolation. However, internet-based interventions that have integrated CBT and MI content designed to target all symptoms simultaneously have only emerged recently. A recent systematic review and *meta*-analysis of the literature examined the effects of online interventions for comorbid alcohol use and depression (Schouten et al., 2021). Of the six studies that met inclusion criteria, they found small significant pooled effects for depression at 3-months ($g = 0.34$) but not at the 6-month follow up, and small significant effects for alcohol at 6-month follow-up ($g = 0.14$) but not 3-months. This review highlights the emergence of an important line of treatment for addiction and mental health that may be more cost-effective than in-person treatments (Yates, 2020). However, programs of this nature are still relatively new, and additional trials are needed. Furthermore, additional programs designed specifically for young adults and that target anxiety explicitly are still needed.

Unfortunately, despite the billions of dollars expended annually on healthcare for this population (Government of Canada, 2015), most people with alcohol problems who also suffer from an emotional disorder do not receive the appropriate treatment required for their complicated needs (Boschloo et al., 2011; Hasin et al., 2007). This is due to numerous existing barriers, including stigma, limited resources, and cost (Priester et al., 2016). At present, existing treatment options for these comorbid problems are not sufficient, and it is therefore critical to develop evidence-based interventions that address the disparity in mental health care for this population.

1.3. Aims and objectives

In light of existing treatment limitations for comorbid alcohol misuse and emotional problems in young adults, the goal of the current study was to examine the efficacy of a novel integrated intervention using online service delivery. We were able to integrate treatment for alcohol use and emotional problems within a single intervention by combining key principles of cognitive behavioural therapy and motivation interviewing (Hofmann et al., 2012; Vasilaki et al., 2006), given the empirical support for both approaches in treating alcohol misuse and emotional symptoms. The utilization of an online modality provides many strengths over traditional approaches. First, online formats are often more accessible both physically and financially than in-person formats (Canadian Medical Association and Canadian Psychiatric Association, 2016; Priester et al., 2016), where there are known barriers to accessing in-person treatment. Second, young adults are often reluctant to seek traditional in person psychological treatment due to the pervasive stigma in doing so (Livingston, Milne, Fang, & Amari, 2012). As such, young adults may be more inclined to participate in an online treatment format due to increased privacy and anonymity. Third, intervening while young adults are experiencing moderate levels of alcohol misuse and emotional problems (i.e., early in the risk pathway) may prevent their symptoms from developing into severe clinical disorders in the future (Deady et al., 2016). Finally, given the billions of dollars being expended on health care, online treatments have potential to reduce the burden on the health care system. Thus, the goal of our program was to improve both efficacy and accessibility of services for young adults struggling with alcohol use, depression, and anxiety.

We took the *Take Care of You* program that targets depression and alcohol misuse simultaneously (Schaub et al., 2016) and is currently being evaluated in German, and adapted it for use in English. The current program, entitled *Take Care of Me*, included additional content to also target anxiety symptomology. We conducted a randomized controlled trial (RCT) with treatment and psychoeducational control groups and obtained outcome data at both short- (8 weeks, T1) and long-term (24 weeks, T2) follow-ups.

The hypotheses were as follows:

1. **Hypothesis 1**: Participants in the integrated treatment condition would show larger reductions in weekly alcohol use (primary outcome) relative to participants in the psychoeducational control group over the course of the 8-week program.
2. **Hypothesis 2**: Participants in the integrated treatment condition were expected to show larger reductions in hazardous drinking, alcohol problems, depression, anxiety, as well as increases in quality of life over the 8-week program relative to controls (secondary outcomes).
3. **Hypothesis 3**: Improvements for the treatment group were expected to be maintained at a 24-week follow-up.

2. Method

2.1. Design

The research was designed in accordance with the ethical principles of the Declaration of Helsinki and reported in accordance with the CONSORT guidelines for internet-based interventions (Eysenbach, 2011), and was granted procedural ethics approval from the Psychology/Sociology Research Ethics Board at the University of Manitoba, P2017:128. The intervention was pre-registered on clinicaltrials.gov for traceability (ID: NCT03406039) and was updated at each stage of the research process. The procedure was conducted in accordance with the published protocol (Frohlich et al., 2018).

The study was an open-label two-arm RCT. Participants were randomly assigned by the web server to either the integrated treatment condition ($n = 114$), or to the psychoeducational control condition ($n = 108$). Assessment data were collected at three distinct time points: baseline (i.e., T0), end of treatment (i.e., T1, 8 weeks), and follow-up (i. e., T2, 24 weeks). Participants received a $10 CAD Amazon gift card for each assessment period they completed, making the total compensation $30 CAD. Researchers and participants were not blinded to group assignment.

2.2. Procedure

2.2.1. Participants

A total of 275 people were initially screened for participation, but 52 did not meet the eligibility criteria and were not included. This resulted in a final sample of 222 participants ($M_{age} = 24.6$, $SD_{age} = 4.37$, 67.6% female) in the trial. Of this sample, individuals identified as: 59.5% White, 10.8% Indigenous, 8.6% Black, 10.8% East/Southeast Asian or Pacific Islander, 2.7% Hispanic or Latino, 2.3% Middle Eastern, North African, or Central Asian, 3.6% South Asian, and 1.8% Other. Participants were recruited from September 2018 to September 2019 using various strategies, including online (e.g., Google Ads, Facebook, emails to university students), and community-based (e.g., posters at doctor's offices and organizations) methods. Eligibility was expanded to the age of 35 in order to provide help more broadly while still remaining within the early life stage (Arnett et al., 2014). The program was compatible for use on all electronic devices (i.e., computers, tablets, and smartphones).

Eligibility for the program included: 1) being between 18 and 35 years old, 2) self-reporting a score of > 3 for females and > 4 for males on the Alcohol Use Disorders Identification Test – Consumption screener (AUDIT-C; Saunders et al., 1993), 3) self-reporting at least moderate depression and/or anxiety symptoms (i.e., scoring > 16 on the Center for Epidemiological Studies Depression Scale [CES-D, Radloff et al., 1997], and/or a score of > 10 on the Generalized Anxiety Disorder Scale [GAD-7, Spitzer et al., 2006], 4) being fluent in English, and 5) having access to the internet. Participants were excluded if: 1) they self-reported engaging in either psychological or pharmacological treatments for alcohol misuse and/or depression/anxiety, 2) scored greater than "minimal risk" on the P4 suicidality screener (Dube et al., 2010), or 3) reported current symptoms of psychosis or mania. Informed consent for participation was provided electronically on the study website prior to registering for an account.

2.2.2. Program overview

Treatment Condition. Once registered, participants in the treatment condition were able to access the program dashboard, which included their mood and drinking diary, 12 treatment modules, a page of mental health and crisis support lines across major Canadian cities, and their user information. Participants were given 8 weeks to complete the treatment modules. While they were given access to all 12 modules at the outset of the program, they were encouraged to work through them in sequential order by completing 1–2 modules per week. Participants were able to return to all modules as many times as desired within the 8 weeks. They were also able to keep track of their progress throughout the program via a status bar at the bottom of each module. Modules were translated and adapted to English from the Swiss version of the intervention (Schaub et al., 2016), with additional content added to target symptoms of anxiety in addition to depression. The 12 modules combined principles of CBT and MI to help participants target goals related to both alcohol consumption and emotional improvement. This included strategies such as realistic goal setting (e.g., reducing the number of overall drinks consumed), coping with craving, learning to decline social invitations to drink, identifying triggers, preventing relapse, challenging negative thinking, relaxation (e.g., deep breathing, muscle relaxation), behavioral activation for improving mood, and self-care (e.g., exercise, sleep hygiene). Modules ranged in length from 3 to 13 pages ($M = 9.4$), which included both educational text and self-directed activities. Extensive information, including module content is included in the previously published protocol (Frohlich et al., 2018).

Individuals also received ongoing feedback from an intervention support person throughout the 8-week program in order to increase treatment adherence. This involved automated feedback about module progress sent via email, automated reminders for timely completion of remaining modules and assessment time points, and automated motivational content. For example, all participants in the intervention condition received a message after the first week congratulating them on completing the week with the message of "at this time, we would also like to encourage you to start another module if you haven't yet done so" and wishing them well in the week ahead. Participants could also troubleshoot any difficulties that arose throughout the program by corresponding with the intervention support person via e-mail. The intervention support person was a research assistant and not a therapist due to the minimally guided nature of the program. Although participants could initiate contact via email, the majority did not, and those that did were primarily seeking administrative support with the program. Participants were also encouraged to track mood and alcohol use using a daily diary calendar on the website.

Control Condition. Participants assigned to the control group were directed to psychoeducational material for alcohol use (www.niaaa.nih. gov/publications/brochures-andfact-sheets) and mental illness (e.g., www.healthymindscanada.ca/resources/) that are readily available to the public. This is common practice for online addiction and mental health RCTs (Garrido et al., 2019; Riper et al., 2014). They did not have access to the treatment modules at the outset but were provided with full access to the intervention upon completion of the 24 weeks.

2.3. Measures

All measures were administered at all three time points (i.e., T0 to T2) with the exception of the suicidality screener (Dube et al., 2010) and the demographic questionnaire which were completed at T0 only.

2.3.1. Primary outcome

The primary outcome was total weekly alcohol consumption using the Timeline Follow-Back (TLFB; Sobell & Sobell, 1992). Participants were asked to report the number of standard drinks (i.e., 12 oz can or bottle of beer, a 5 oz glass of wine, or a 1.5 oz shot of hard liquor) consumed each day for the past week. This value was then summed to calculate the number of standard drinks in the past week for each assessment time point. The TLFB is widely used in addictions research and is considered a reliable and valid representation of alcohol consumption (Mohr et al., 2011; Pedersen et al., 2012).

2.3.2. Secondary outcomes

Depression. Depression was assessed using the CES-D (Radloff, 1977), which has excellent reliability and validity evidence in treatment research (González et al., 2017). Sum scores were calculated and the CES-D internal consistency at baseline was good ($\alpha = 0.86$).

Anxiety. The GAD-7 (Spitzer et al., 2006) was used to assess anxiety. Sum scores were calculated and the GAD-7 internal consistency was good at baseline ($\alpha = 0.80$).

Alcohol Problems. In addition to quantity of drinking using the TLFB, participants completed the 10-item Alcohol Use Disorder Identification Test (AUDIT; Saunders et al., 1993), a self-report screener for alcohol-related problems. The AUDIT has demonstrable reliability and validity evidence in addictions research (Saunders et al., 1993), and yielded good internal consistency at baseline within the present sample ($\alpha = 0.86$). We looked at both the AUDIT-C (i.e., hazardous drinking) and the full AUDIT as outcome variables. Given that the AUDIT-C was a main inclusion criterion, it was important to examine whether change was observed for this variable.

Combined Reduction of Alcohol Use and Emotional Problems. Given the interconnectedness between alcohol use and emotional difficulties, a combined outcome was also examined. This was done by calculating a dichotomous variable for each participant based on cut-off

scores from the CES-D (i.e., scoring below 16), GAD-7 (i.e., scoring below 5), and the first three items of the AUDIT (i.e., the AUDIT-C; scoring below 3 for females and 4 for males), all of which would suggest that participants were no longer experiencing clinical levels of emotional distress or problematic drinking. Participants no longer exceeding cut-offs for both alcohol misuse and emotional problems were coded as 0, whereas those exceeding cut-offs on the AUDIT and at least one emotion measure were coded as 1.

Quality of Life. An additional secondary outcome was participants' overall quality of life, which was measured using the World Health Organization Quality of Life Assessment (WHOQOL-BREF, WHOQOL Group, 1998). The questionnaire includes 26 self-report items that assess quality of life in four distinct domains. The reliability of each subscale was acceptable, physical health ($\alpha = 0.71$), psychological ($\alpha = 0.70$), social relationships ($\alpha = 0.61$), and environment ($\alpha = 0.76$), with the exception of the social subscale which fell in the questionable range.

Drug Use. In order to assess potential reductions in other drug use, participants reported their levels of use over the past three months using the National Institute on Drug Abuse Alcohol, Smoking, and Substance Involvement Screening Test (NIDA ASSIST; NIDA, 2009). The NIDA ASSIST is a widely utilized tool within addictions research and treatment studies, with strong reliability and validity (Humeniuk et al., 2008).

Motivation. Given the fact that motivational content was deliberately included in the treatment program, participants also reported their readiness to improve their emotional well-being and alcohol use issues, how important it was to make said changes, and how confident they were in their ability to make changes at the time. Single items were created to assess participants' level of motivation from 0 *(Not Important/Confident/Ready)* to 10 *(Very Important/Confident/Ready)*.

Demographics. Demographic information was collected from participants at T0 to describe the sample and determine eligibility. This included age, biological sex, gender, ethnicity, history and treatment for any physical or mental conditions, and family history of alcoholism. A family history density of alcoholism score was also calculated for each participant by calculating the unique contribution of risk from first (i.e., 0.5)- and second-degree (i.e., 0.25) relatives (Stoltenberg et al., 1998).

2.4. Statistical analysis

2.4.1. Power

Based on the results of similar interventions utilizing CBT and MI for alcohol use and depressive symptoms (Schouten et al., 2021), we anticipated small effect sizes of $g = 0.25$ for both drinking measures and emotional symptoms following the intervention. We used G*Power to calculate the optimal sample size to detect a small (i.e., 0.2) effect with 80% power, $\alpha = 0.05$, and a correlation of 0.50 between repeated measures using a mixed between (treatment versus control) within (time) design. This resulted in a total sample of $N = 164$. However, we also considered previous online trials for alcohol use and depression as a benchmark for estimating attrition rates, which was expected to be approximately 30% lost at follow-up (Deady et al., 2016). Thus, we aimed to recruit a sample of at least 214 participants in order to mitigate the risk of attrition.

2.4.2. Data analytic plan

Data was analyzed using SPSS version 25.0. First, we ran preliminary analyses on the dataset (i.e., descriptives, missing data analyses) to observe trends within the sample and identify any systematic missingness, which allowed us to include relevant covariates in the main analyses. We also calculated the proportion of participants who fell below clinical cut-offs on the AUDIT, CES-D and GAD-7 at the end of treatment. Initial analyses revealed that the retention rate at T1, though lower than anticipated and suboptimal, was similar to previous interventions (Hadjistavropoulos et al., 2020) at 55% ($n = 122$), with an equal 50% in each group (i.e., $n = 61$ in the treatment group, $n = 61$ in the control group). However, despite efforts to mitigate attrition in study

procedures (e.g., accountability checks, automatic reminders, and compensation), we experienced far higher rates of attrition at 24 weeks (i.e., T2) than anticipated. We predicted that attrition rates at 24 weeks would be approximately 30%, whereas only 75 out of 222 participants were retained (i.e., 66% drop-out rate). Furthermore, attrition at the 24-week follow-up was very biased, as only 18 of the remaining participants were from the control condition (i.e., ~ 8% of the entire sample).

Next, in accordance with the previously published protocol (Frohlich et al., 2018), we used Generalized Linear Mixed Models (GLMM) with an intent-to-treat (ITT) framework to examine immediate treatment effects at T1, thus testing Hypotheses 1 (primary outcome) and 2 (secondary outcomes). GLMM was also used to examine longer-term treatment effects at follow-up (i.e., T2), thus testing Hypothesis 3. However, it is important to note that the systematic and substantial attrition experienced at 24 weeks is a notable limitation and may have negatively impacted our power to detect an interaction effect at the longer-term follow-up (Groenwold et al., 2014). For all main analyses, we used separate mixed models to examine the effects of time (within-subjects), intervention (between-subjects), and intervention by time interaction on the primary and second outcomes. The trend for time was linear, random intercepts (but not random slopes) were specified, and all outcomes were treated as continuous with the exception of the dichotomous combined reduction outcome. Relevant covariates were also included in the models (i.e., sex, age, family history of alcoholism, baseline AUD symptomology) based on the missing data analysis, with the goal of reducing potential biases associated with systematic data loss (Preacher et al., 2010).

3. Results

3.1. Descriptive Statistics and missing data analysis

See Fig. 1 for the CONSORT trial flow chart. Demographic information for each condition is presented in Table 1. Some participants

Table 1
Descriptive Statistics of Study Variables by Group at Baseline.

Variable	Intervention	
	Treatment (n = 114)	Control (n = 108)
Age, M (SD)	24.83(4.44)	24.30 (4.30)
Sex, % (n)		
Female	69.3 (79)	65.7 (71)
Male	30.7 (35)	33.3 (36)
Ethnicity, % (n)		
Indigenous	8.8 (10)	13.0 (14)
Black	7.9 (9)	9.3 (10)
White	57.0 (65)	62.0 (67)
East Asian/South- East Asian/Pacific Islander	14.0 (16)	7.4 (8)
Hispanic	4.4 (5)	0.9 (1)
Middle Eastern/North African/Central Asian	2.6 (3)	1.9 (2)
South Asian	4.4 (5)	2.8 (3)
Other	0.9 (1)	2.8 (3)
Family History Density, M (SD)	0.75 (0.67)	0.84 (0.58)
TLFB, M (SD)	18.3 (16.97)	19.77 (17.09)
CES-D, M (SD)	32.55 (9.59)	33.63 (9.78)
GAD-7, M (SD)	11.98 (4.32)	13.02 (4.56)
AUDIT, M (SD)	16.05 (7.84)	17.56 (8.07)
NIDA-Cannabis, M (SD)	1.99 (2.05)	2.14 (1.98)
QOL-Physical, M (SD)	13.47 (2.65)	13.16 (2.41)
QOL-Psychological, M (SD)	10.16 (2.40)	10.36 (2.58)
QOL-Social, M (SD)	11.07 (5.60)	10.96 (3.62)
QOL-Environmental, M (SD)	13.42 (2.67)	13.40 (2.77)
Importance, M (SD)	7.88 (1.99)	7.72 (2.23)
Confidence, M (SD)	6.63 (2.18)	6.29 (1.84)
Readiness, M (SD)	7.85 (1.92)	7.31 (2.15)

Note. TLFB = Timeline Follow-Back, CES-D = Center for Epidemiological Studies Depression Scale, GAD-7 = Generalized Anxiety Disorder Scale, AUDIT = Alcohol Use Disorders Identification Test, NIDA = National Institute on Drug Abuse Alcohol, Smoking, and Substance Involvement Screening Test, QOL = World Health Organization Quality of Life Assessment.
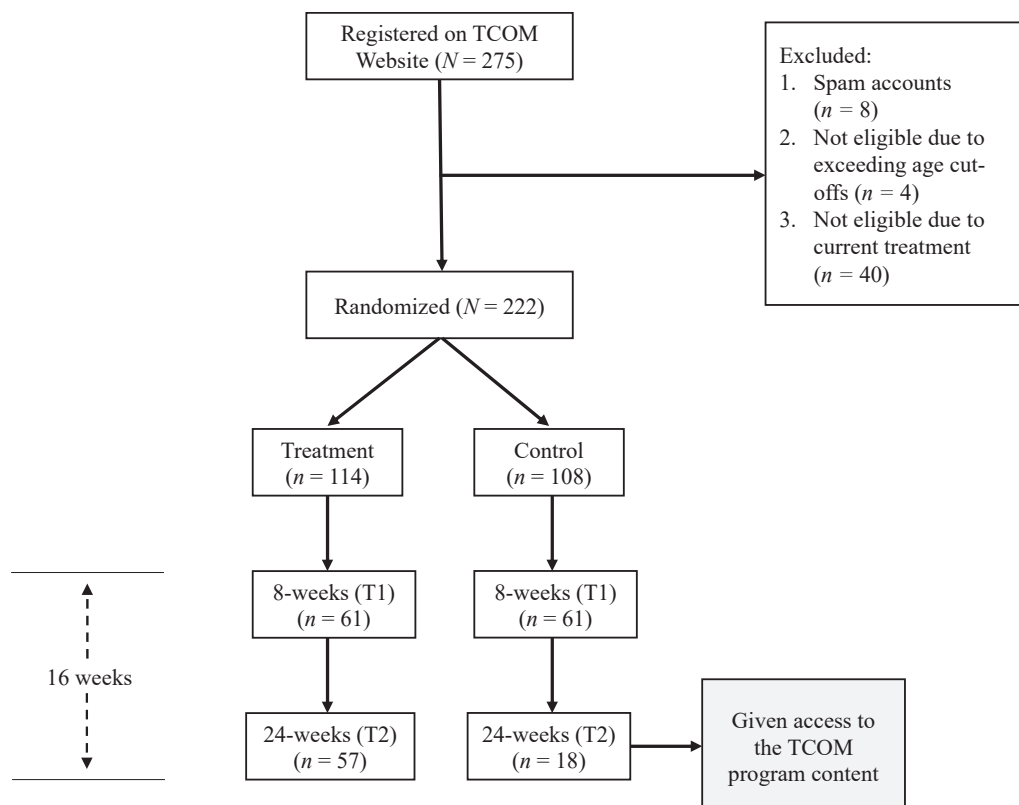

Fig. 1. CONSORT Trial Flow Chart.

reported having a mental health diagnosis (i.e., 32.4%) and seeking either pharmacological or psychological treatment in the past (i.e., 33.3%). The mean number of modules completed by those in the treatment group was 3.03 ($SD = 4.58$), with only 14.4% completing all 12 modules. Missing data analyses were conducted using independent samples t-test and hierarchical linear regressions. Results of the t-tests revealed that individuals with missing data at the end of treatment differed significantly from those with complete data on baseline TLFB (t $(220) = 2.20, p = .029, Cohen's d = 0.29$) and AUDIT ($t(218) = 2.98, p = .003, d = 0.40$) scores. The groups did not differ significantly on baseline depression ($t(220) = 0.79, p = .43, Cohen's d = 0.11$) or anxiety ($t(220) = 1.81, p = .07, Cohen's d = 0.25$) scores. Next, regressions were used to examine relevant auxiliary variables that accounted for missingness in baseline TLFB and AUDIT scores. The dichotomous missingness variable was included in Step 1, and relevant covariates (i.e., sex, age, family history of alcoholism, and baseline AUDIT, depression, and anxiety) were included in Step 2. In both the TLFB and AUDIT models, the missing data variable emerged as a statistically significant predictor of baseline scores in Step 1, but the effects became non-statistically significant in Step 2 ($p = .95$ and 0.058, respectively). Identifying the sources of systematic missingness and being able to control for them in the linear models allowed us to consider the data sufficiently MAR, permitting us to use GLMM with full information maximum likelihood estimation.

3.2. Preliminary analyses

While descriptive in nature, it was also valuable to report the proportion of individuals still above at-risk cut-off levels for each main variable at the end of treatment (i.e., T1). The percentage of individuals exceeding cut-offs on the AUDIT-C (collapsed across gender) was 70% for the treatment group and 88% for the control group. For depressive symptoms, 69% of individuals in the treatment group and 85% in the control group still exceeded cut-offs at T1. Finally, 79% of individuals in the treatment group and 90% in the control group remained above cut-offs for at least moderate anxiety at T1. This suggests that despite immediate improvements on these variables, most people continued to struggle with emotional symptoms at the end of treatment.

3.3. Main trial analyses

Separate mixed effect models were run for each outcome. Non-statistically significant model results are presented in the supplementary file.

Hypothesis 1. Immediate Effects on the Primary Outcome

Contrary to our predictions, there was no statistically significant interaction effect on participants' weekly alcohol use as measured by the TLFB ($p = .219$); thus, Hypothesis 1 was not supported. Results of the analysis are presented in the supplementary file.

Hypothesis 2. Immediate Effects on the Secondary Outcomes

Hazardous Drinking. Separate mixed effects models were run for each secondary outcome in order to test Hypothesis 2. The AUDIT covariate added to the models was the full AUDIT score minus the AUDIT-C items. Inconsistent with our hypotheses, there were no statistically significant immediate interaction effects on AUDIT scores using the full measure (see supplementary file). Interestingly, however, the time by condition interaction was statistically significant ($p = .024$) for the AUDIT-C. While we observed statistically significant reductions in both groups over the 8 weeks of treatment ($B = -1.57, SE = 0.23, p < .001$ for the treatment group, $B = -0.91, SE = 0.26, p = .001$ for the control group), the interaction term suggests that participants in the treatment condition showed larger reductions in hazardous drinking during the intervention period compared to those in the control condition.

Emotional Outcomes. The results of the mixed model analyses for

emotional outcomes at 8 weeks are presented in Table 2 and partially supported our hypotheses. With regard to depression, there was a statistically significant time by condition interaction ($p = .036$). Furthermore, while both groups were changing over time, participants in the treatment group showed larger reductions in depressive symptoms compared to those in the control condition ($B = -7.96, SE = 1.34, p < .001, B = -3.84, SE = 1.52, p = .012$, respectively, see Fig. 2). For anxiety, the time by condition interaction was not supported. There were no statistically significant changes in combined alcohol use and emotional difficulties (see supplementary file).

Quality of Life. The only immediate effect on quality of life was in the psychological domain, where the time by condition interaction was statistically significant ($p = .015$; see Table 3). Participants in the treatment group experienced a statistically significant improvement in scores over the 8 weeks ($B = 1.38, SE = 0.29, p < .001$) while those in the control group did not ($B = 0.22, SE = 0.40, p = .577$; see Fig. 2). No statistically significant effects were observed for the remaining quality of life domains.

Drug Use. Likewise, there was no statistically significant immediate effects on participants' self-reported levels of drug use other than alcohol using the NIDA (see supplementary file), which is inconsistent with our hypothesis.

Motivation. The final set of variables examined were the motivational outcomes (see Table 3). The time by condition interaction was statistically significant for treatment readiness ($B = -1.20, p = .004$). Participants in the control group experienced a statistically significant reduction in treatment readiness over the intervention period ($B = -1.11, SE = 0.34, p = .001$), whereas this effect was not statistically significant in the treatment group ($B = 0.04, SE = 0.28, p = .88$; see Fig. 2). There was no statistically significant interaction on confidence. However, participants in the treatment group reported statistically significant increases in their confidence over 8 weeks ($B = 0.89, SE = 0.25, p = .001$), while those in the control group did not ($B = 0.27, SE = 0.32, p = .402$).

Hypothesis 3. Follow-up Effects

Overall, we did not observe the expected follow-up treatment effects on our primary outcome of interest (i.e., weekly alcohol use using the TLFB), nor on the majority of the secondary outcomes at 24 weeks (see

Table 2
Hypothesis 2 – End of Treatment Model for Secondary Outcomes (Drinking and Depression).

Parameter	B	Std. Error	t	Sig.
Hazardous Drinking (Brief Version)				
Intercept	5.24	0.50	10.57	< 0.001
Group	−0.52	0.46	−1.13	0.261
Time	−1.58	0.22	−7.23	< 0.001
AUDIT – Cov	0.22	0.01	15.09	< 0.001
CES – Cov	−0.02	0.01	−1.23	0.22
GAD – Cov	0.01	0.03	0.20	0.842
Sex	0.02	0.01	1.33	0.186
Age – Cov	−0.00	0.00	−0.20	0.839
Time × Intervention	**0.71**	**0.31**	**2.27**	**0.024**
Family History – Cov	−0.01	0.17	−0.06	0.956
Depression				
Intercept	25.10	2.65	9.48	< 0.001
Time	−7.10	1.34	−5.94	< 0.001
AUDIT- Cov	0.04	0.08	0.50	0.62
GAD – Cov	1.18	0.13	9.08	< 0.001
Sex	0.04	0.08	0.54	0.588
Age	0.01	0.02	0.59	0.556
Family History – Cov	0.56	0.96	0.58	0.562
Group	−3.88	2.81	−1.38	0.168
Time × Intervention	**4.08**	**1.93**	**2.11**	**0.036**
Intercept	25.10	2.65	9.48	< 0.001

Note. Secondary drinking outcome for hazardous drinking was the AUDIT-C and for depression was the CES-D at the end of treatment (i.e., T1). "Cov" denotes the inclusion of a relevant covariate.

AUDIT-C Scores

Depression Symptom Scores

Psychological Quality of Life

Confidence
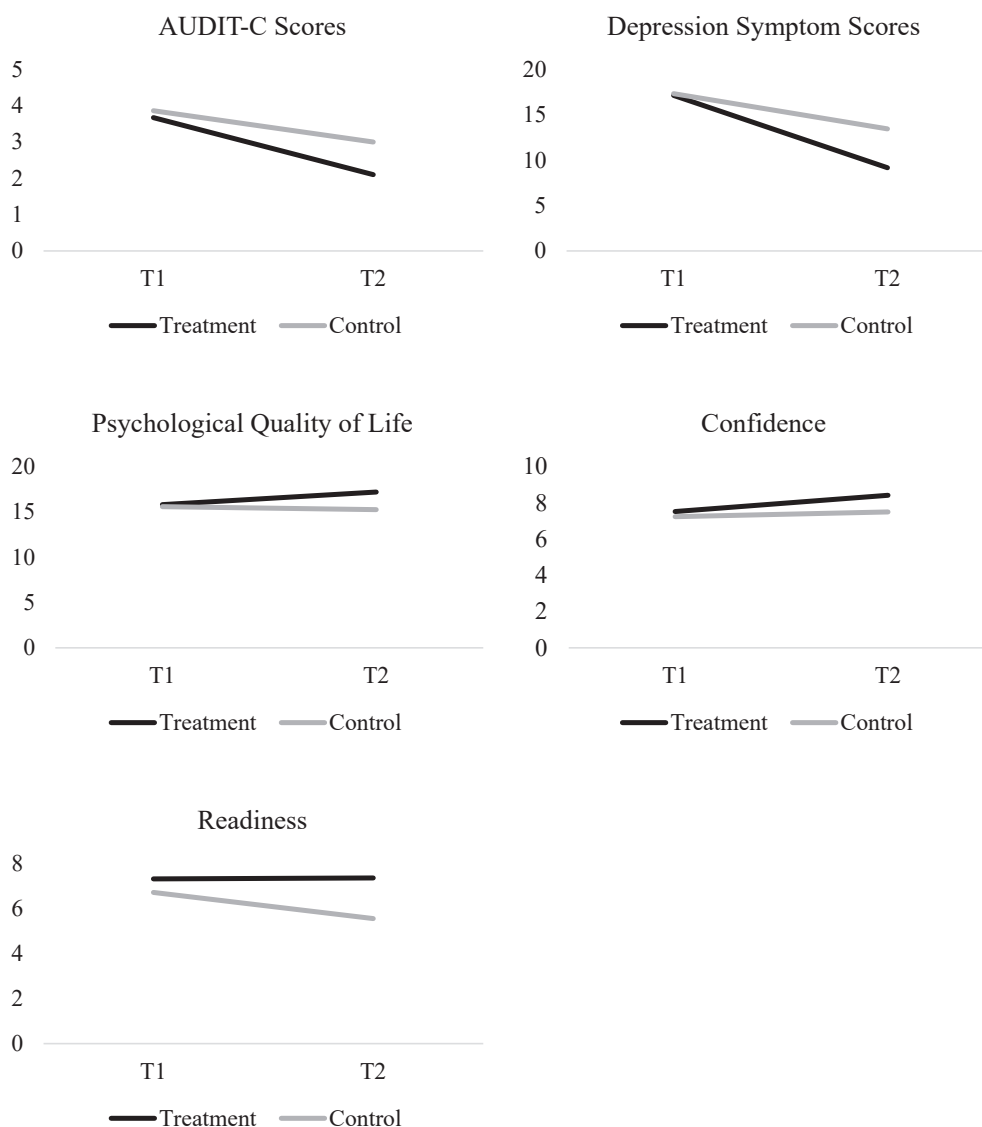
Readiness

Fig. 2. Changes in Hazardous Drinking, Depression, and Motivation from Pre- to Post- Treatment. *Note:* Time × Condition interactions were significant for AUDIT-C (*p* = .024), depression (*p* = .036), psychological quality of life (*p* = .015) and readiness (*p* = .004).

supplementary file). However, the time by condition interaction was statistically significant for hazardous drinking (i.e., the AUDIT-C; *p* = .026). Furthermore, individuals in the treatment group experienced larger reductions in hazardous drinking than those in the control group (*B* = -1.34, *SE* = 0.171, *p* = <0.001, *B* = -0.67, *SE* = 0.242, *p* = .006, respectively, see Table 4). Graphical representations of interaction effects are presented in Fig. 3.

While we did not observe any other statistically significant treatment effects on mental health outcomes when we included the 24-week follow-up data, we did observe statistically significant interaction effects on three of the four quality of life domains, despite one being marginally significant. The treatment group significantly improved over time for the psychological (*B* = 0.89, *SE* = 0.22, *p* < .001), social (*B* = 0.84, *SE* = 0.32, *p* = .01), and environmental (*B* = 0.47, *SE* = 0.22, *p* = .039) domains, whereas the control group did not (see Table 4).

4. Discussion

The overarching goal of the current study was to develop and examine the efficacy of an online, minimally guided, integrated treatment for young adults struggling with comorbid alcohol misuse and emotional problems. Given the high comorbidity between the disorders, it is important that accessible, efficacious, and economical treatment options exist for these individuals, particularly those who are early on in the risk pathway for more severe disorders later in life. Our program was the first online integrated treatment for use in English designed to address this comorbidity in young adults, and the first intervention of its kind to integrate treatment for both alcohol use and the full range of emotional symptomology (i.e., depression *and* anxiety).

Overall, we did not observe significant effects on the primary outcome (i.e., total weekly alcohol use) at the end of treatment. However, we did observe meaningful effects on several secondary outcomes. At the end of treatment, we observed immediate reductions in hazardous drinking (i.e., AUDIT-C) and depression, as well as increases in psychological quality of life and confidence for change. As discussed, we experienced challenges with differential and high attrition at the longer-term follow-up. While we did observe some indication that the program led to longer-term decreases in hazardous drinking (i.e., the AUDIT-C) and multiple domains of quality of life, we did not see expected effects on our primary measure of alcohol consumption or measures of depression and anxiety being maintained over time. Overall, these results should be interpreted with caution given the substantial and

Table 3

Hypothesis 2 – End of Treatment Model for Secondary Outcomes (Quality and Motivation).

Parameter	B	Std. Error	t	Sig.
Psychological				
Intercept	14.41	0.69	20.98	< 0.001
Time	1.38	0.29	4.70	< 0.001
AUDIT - Cov	−0.02	0.02	−0.91	0.364
Sex	−0.02	0.02	−0.87	0.386
Age	−0.00	0.00	−0.09	0.927
Family History - Cov	−0.05	0.24	−0.22	0.822
CESD - Cov	−0.12	0.02	−6.93	< 0.001
GAD - Cov	−0.11	0.04	−2.79	0.006
Group	1.49	0.62	2.38	0.018
Time × Intervention	**−1.04**	**0.42**	**−2.47**	**0.015**
Confidence				
Intercept	6.62	0.62	10.73	< 0.001
Time	0.90	0.26	3.49	0.001
Sex	−0.02	0.02	−1.11	0.268
Age	0.00	0.00	0.27	0.787
Family History - Cov	0.30	0.22	1.35	0.178
CESD - Cov	−0.01	0.02	−0.75	0.454
GAD - Cov	0.00	0.04	0.03	0.979
Group	0.35	0.55	0.64	0.523
Time × Intervention	−0.64	0.37	−1.72	0.088
AUDIT - Cov	−0.05	0.02	−2.59	0.01
Readiness				
Intercept	7.28	0.65	11.18	< 0.001
Time	0.04	0.29	0.14	0.884
Sex	−0.00	0.02	−0.03	0.977
Age	−0.00	0.00	−0.89	0.374
Family History - Cov	0.64	0.22	2.83	0.005
CESD - Cov	−0.01	0.02	−0.50	0.62
GAD - Cov	0.01	0.04	0.32	0.747
AUDIT - Cov	0.02	0.02	0.89	0.376
Group	0.59	0.60	0.99	0.325
Time × Intervention	**−1.20**	**0.41**	**−2.93**	**0.004**

Note. Outcome variable for quality of life was the psychological subscale of the WHOQOL-BREF and motivation outcomes were single items assessed at the end of treatment (i.e., T1). "Cov" denotes the inclusion of a relevant covariate. Significant interaction is bolded.

Table 4

Hypothesis 3 – Follow-up Model for Secondary Outcomes (Drinking and Quality of Life).

| Parameter	B	Std. Error	t	Sig.
Hazardous Drinking				
Intercept	7.87	0.36	22.17	< 0.001
Sex	0.31	0.23	1.35	0.176
Intervention	−0.38	0.53	−0.71	0.476
Time	−1.34	0.18	−7.59	< 0.001
Time × Intervention	**0.67**	**0.30**	**2.23**	**0.026**
Age - Cov	0.06	0.03	2.19	0.029
Family History - Cov	−0.06	0.21	−0.29	0.766
CESD - Cov	−0.02	0.01	−1.61	0.113
GAD - Cov	0.03	0.03	1.13	0.26
AUDIT – Cov *(AUDIT-C items excluded)*	0.19	0.02	10.27	< 0.001
Psychological				
Intercept	9.30	0.45	20.84	< 0.001
Sex	−0.01	0.30	−0.05	0.96
Intervention	1.32	0.67	1.97	0.049
Time	0.89	0.22	4.01	< 0.001
Time × Intervention	**−1.01**	**0.38**	**−2.66**	**0.008**
Age - Cov	0.03	0.03	0.095	0.352
Family History - Cov	0.03	0.26	0.12	0.906
AUDIT - Cov	−0.02	0.02	−1.27	0.212
CES-D - Cov	−0.10	0.02	−5.52	< 0.001
GAD-7 - Cov	−0.14	0.04	−3.68	< 0.001
Environmental				
Intercept	12.91	0.45	28.52	< 0.001
Sex	−0.09	0.30	−0.29	0.773
Intervention	1.20	0.68	1.77	0.077
Time	0.47	0.23	2.07	0.039
Time × Intervention	**−0.92**	**0.38**	**−2.40**	**0.016**
Age - Cov	0.01	0.03	0.34	0.744
Fam History - Cov	−0.18	0.27	−0.66	0.506
AUDIT - Cov	−0.01	0.02	−0.52	0.59
CES-D - Cov	−0.08	0.02	−4.46	< 0.001
GAD-7 - Cov	−0.20	0.04	−5.12	< 0.001

Note. Outcome variable for hazardous drinking was the AUDIT-C, and for quality of life were two subscales of the WHOQOL-BREF at follow-up (i.e., T2). "Cov" denotes the inclusion of a relevant covariate. Significant interaction is bolded.

differential attrition we experienced at follow-up, which poses a threat to the validity of the data. We therefore cannot conclude whether Hypothesis was 3 was supported or not. Although we need to remain cautious about the trial findings, our results reflect some preliminary support for *Take Care of Me* in the short-term.

4.1. Principal results and comparison with prior work

The results of our study revealed that at the end of the 8-week program, individuals in the treatment group did not experience a significant reduction in overall alcohol consumption using the TLFB, but they did experience significant improvements on hazardous drinking (i.e., AUDIT-C). This is inconsistent with previous research and our first hypothesis, which demonstrated that combined CBT and MI resulted in small but significant reductions in alcohol consumption using internet formats (Deady et al., 2016), and this effect was maintained at follow-up (Schouten et al., 2021). At present, we are left to speculate why the program did not significantly reduce overall alcohol consumption (i.e., TLFB). One possibility is the distinction between overall alcohol use and hazardous drinking, whereby one does not necessarily equal the other (e.g., a total of seven drinks in one day vs. spread over one week). The module content in the current program was designed to reduce the risk of short- and long-term consequences of heavy drinking. Therefore, it is possible that participants were reducing their overall level of risk, but the quantity of drinks they consumed in a given week did not significantly decrease. This might have happened, for example, if participants had two drinks on four occasions in a week, rather than eight drinks on one occasion. The AUDIT-C is also a well-established measure of

hazardous drinking within addictions literature, including for use among young adults (Verhoog et al., 2020), and was the measure we used to determine eligibility during enrolment. It plausible that we observed immediate treatment benefits on the AUDIT-C and not the TLFB because it is more sensitive to changes in hazardous drinking than simply quantity of consumption.

With regard to secondary emotion outcomes, our second hypothesis for immediate treatment effects was partially supported. Consistent with previous treatment of this nature (Etzelmueller et al., 2020; Hofmann et al., 2012), individuals in the program experienced a significant reduction in depressive symptoms over the course of the 8 weeks. This supports the notion that integrated treatment works, as individuals can change both their drinking and emotions simultaneously. Similar to the aforementioned findings with risky drinking, we are unable to conclude whether the benefits on emotional symptoms were lost at follow-up, or whether we were simply underpowered to detect such an effect long-term.

We also observed immediate effects on psychological quality of life, and the effect on many facets of quality of life were observed at the longer-term follow-up. This suggests that in addition to reductions on secondary clinical outcomes, the 8-week program also had a positive impact on individuals' psychological, social, and environmental well-being. Although not always included in clinical research studies, quality of life has been deemed an important indicator of success in mental health treatment (Oliveira et al., 2016), including treatment for substance use (Kirouac et al., 2017). This suggests that in addition to the clinical outcomes, these findings are meaningful for participants and a
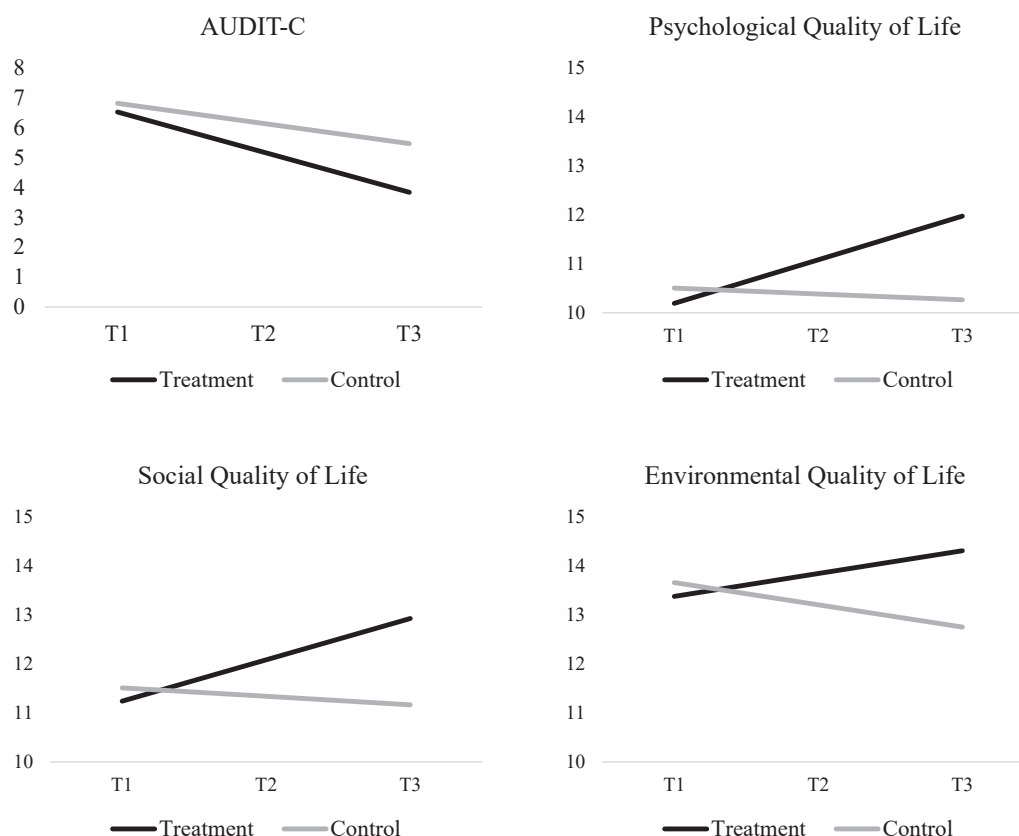
Fig. 3. *Changes in Hazardous Drinking and Quality of Life Over Time from Pre-treatment to Follow-up Note:* Time × Condition interactions were significant for the AUDIT-C ($p = .026$), psychological ($p = .008$) and environmental domains ($p = .016$).

further indicator of preliminary support for the program. We also observed significant improvements on one facet of motivation (i.e., treatment readiness) at the end of treatment. Given that motivation, namely treatment readiness, significantly increased in the treatment group but not the control group, it is possible that these individuals would now be ready to engage in further treatment to reduce alcohol consumption in the future.

We also predicted that the benefits of the program would be maintained at the 24-week follow-up. While we observed significant effects on hazardous drinking and quality of life at follow-up, systematic and high attrition may have threatened our power to detect long-term impacts. Thus, we cannot conclude whether our non-significant results at follow-up are due to reduced power or a genuine lack of treatment effects. A main focal point in future iterations of the program should be to improve retention and recruit a large sample in order to clarify the impacts of the program. It is important to note that a recent review of internet-delivered CBT by Hadjistavropoulos and colleagues (2020) found that 2 out of the 11 included studies saw attrition rates>60% at follow-up, and an additional 8 saw attrition rates between 30 and 50%. While our attrition rates at follow-up were also biased against the control group, our findings taken in the context of overall internet-based programs suggest that this is an ongoing challenge for addictions researchers in the field.

4.2. Implications

Overall, our results offer preliminary evidence that 8 weeks of minimally guided online CBT and MI can have positive effects on hazardous drinking, depression, motivation, and quality of life. From a research perspective, this adds to the body of literature demonstrating synergistic benefits of CBT and MI in integrated treatment programs (Riper et al., 2014; Westra et al., 2016). This suggests that theoretically,

programs of this nature can in fact target the emotional symptoms commonly experienced by young adults who are also struggling with alcohol use.

The current program is an important addition to addictions literature with regard to internet interventions. Online support is becoming increasingly popular in this field (Cunningham et al., 2020; Schouten et al., 2021), and is especially timely amidst an ongoing global pandemic where lack of accessibility for in-person activities and the potential for increases in mental health concerns persist (Wardell et al., 2020). While preliminary in nature, our findings suggest that integrated CBT and MI can yield benefits for both depression and anxiety in addition to alcohol misuse. While the program itself needs to be more widely tested in the future, its format offers advantages for low cost and accessible public health style interventions.

It is also important to note many individuals were still meeting cut-offs for risky drinking and emotional problems at the end of treatment. This is not entirely surprising given that we included individuals with a wide spectrum of problems, including those with severe alcohol problems. This was done in order to collect preliminary data on the efficacy of the program overall. However, the literature shows that people with severe problems (i.e., AUDIT > 20) may require residential treatment to address their needs, and low intensity brief interventions are more commonly indicated for less severe problems, as has been shown using the Screening, Brief Intervention and Referral to Treatment (SBIRT) initiative (Del Boca et al., 2017).

4.3. Limitations and future directions

Despite the strengths of the current study, there are important limitations. First and foremost, we experienced substantial biased attrition at the 24-week follow-up, despite our attempts at mitigating data loss (i. e., social presence, engaging activities, automated reminders, monetary

incentives). This may have been in part due to the use of a waitlist control group, which may have increased the risk for biased attrition (Ainsworth et al., 2010). This prevents us from drawing any concrete inferences about the longer-term impacts of the program on the primary outcome measures as intended. Participant retention is consistently reported as a challenge in internet-based treatment programs, particularly individuals with mood (Gill et al., 2014), or substance-use difficulties (Hadjistavropoulos et al., 2020). Future iterations of the program should prioritize retention strategies beyond those employed in the current trial in order to prevent systematic attrition. For example, Scott (2004) has highlighted the potential benefits of proactively following a standardized protocol for reducing attrition, entitled the Engagement, Verification, Maintenance and Confirmation (EVMC) Protocol. The EVMC protocol could be adapted for use within internet-based programs in order to reduce high rates of attrition. Future iterations could also aim to keep more intensive contact with study participants in order to prevent study non-response at all time points.

Additionally, empirical support for the use of therapist assistance within internet-based interventions is growing. Indeed, online interventions for alcohol misuse that incorporate therapist assistance have been found to yield larger effect sizes than minimal or self-guided programs, and some studies have found that attrition is lower, and engagement is higher with an explicit accountability component (e.g., therapist assistance; Hadjistavropoulos et al., 2020). This may be particularly important for individuals with clinically elevated depression, who are likely to experience greater benefits with therapist assistance than completing a self-directed program (Karyotaki et al., 2021). Future research will reveal the optimal format by which to provide said assistance (Sundström, Hadjistavropoulos, Wilhelms, Keough, & Schaub, 2020), but therapist assistance presents a promising future avenue.

A second limitation, which is likely related to overall the attrition, was that engagement with the program content itself was low, as evidenced by the fairly low module completion rate. The goal of the program was to integrate treatment content using a minimally guided framework, which had not previously been done. It is possible that many of the individuals struggling with comorbid alcohol misuse and emotional problems are experiencing difficulties with motivation and energy as well. Although the program was effective for some of the participants, engaging in treatment that is largely self-guided may have been too challenging for all individuals involved, such as those with more severe symptoms.

Finally, aiming to recruit an increasingly diverse sample would help with the generalizability of the findings to different groups. This could include subclinical populations, individuals living in remote areas, and a more ethnically representative sample as nearly 60% of the sample identified as White. Furthermore, the results may not generalize to all individuals of all ages (e.g., older adults), although the module content relied on core principles of CBT and MI that we would expect to yield benefits across the lifespan. An important next step of this research will be to examine relevant moderators and mediators of treatment effects with this data sample, which we intend to do after publishing these primary and planned findings. This may provide insight into the lack of significant effects on alcohol consumption, the fact that both the treatment and control group seemed to benefit from the program at the end of treatment, and the potential impact of baseline symptom severity (e.g., AUDIT scores) on treatment effectiveness.

5. Conclusions

Take Care of Me adds to the emerging body of work designed to target alcohol use and emotional problems in one treatment. By adapting and designing an integrated, internet-based, minimally guided treatment program, we found preliminary evidence that at the end of treatment, young adults experienced a reduction in hazardous drinking, emotional symptoms and an improvement in quality of life. Overall, this is promising initial evidence for the first iteration of the program. Taking into consideration the above limitations, the program could be readily adapted and has the potential for far reaching benefits at both the individual (e.g., symptom reduction, improved quality of life, preventing the escalation of severe clinical disorders) and societal (e.g., reduce disease burden) level.

CRediT authorship contribution statement

Jona R. Frohlich: Conceptualization, Methodology, Formal analysis, Investigation, Resources, Data curation, Writing – original draft, Writing – review & editing, Project administration. **Karli K. Rapinda:** Resources, Writing – review & editing. **Michael P. Schaub:** Conceptualization, Methodology, Writing – review & editing, Funding acquisition. **Andreas Wenger:** Software, Data curation, Writing – review & editing. **Christian Baumgartner:** Software, Writing – review & editing. **Edward A. Johnson:** Funding acquisition, Conceptualization, Writing – review & editing. **Roisin M. O'Connor:** Funding acquisition, Writing – review & editing. **Norah Vincent:** Funding acquisition, Writing – review & editing. **Matthijs Blankers:** Funding acquisition, Writing – review & editing. **David D. Ebert:** Writing – review & editing. **Heather D. Hadjistavropoulos:** Writing – review & editing. **Corey S. Mackenzie:** Writing – review & editing. **Jeffrey D. Wardell:** Writing – review & editing. **Mareike Augsburger:** Writing – review & editing, Formal analysis. **Joel O. Goldberg:** Writing – review & editing. **Matthew T. Keough:** Conceptualization, Methodology, Formal analysis, Investigation, Resources, Data curation, Writing – review & editing, Supervision, Funding acquisition.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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