



THE UNIVERSITY *of* EDINBURGH

## Edinburgh Research Explorer

# A systematic review and behaviour change technique analysis of remotely delivered alcohol and/or substance misuse interventions for adults

### Citation for published version:

Howlett, N, García-Iglesias, J, Bontoft, C, Breslin, G, Bartington, S, Freethy, I, Huerga-Malillos, M, Jones, J, Lloyd, N, Marshall, T, Williams, S, Wills, W & Brown, K 2022, 'A systematic review and behaviour change technique analysis of remotely delivered alcohol and/or substance misuse interventions for adults', *Drug and Alcohol Dependence*, vol. 239, 109597. <https://doi.org/10.1016/j.drugalcdep.2022.109597>

### Digital Object Identifier (DOI):

[10.1016/j.drugalcdep.2022.109597](https://doi.org/10.1016/j.drugalcdep.2022.109597)

### Link:

[Link to publication record in Edinburgh Research Explorer](#)

### Document Version:

Publisher's PDF, also known as Version of record

### Published In:

Drug and Alcohol Dependence

### General rights

Copyright for the publications made accessible via the Edinburgh Research Explorer is retained by the author(s) and / or other copyright owners and it is a condition of accessing these publications that users recognise and abide by the legal requirements associated with these rights.

### Take down policy

The University of Edinburgh has made every reasonable effort to ensure that Edinburgh Research Explorer content complies with UK legislation. If you believe that the public display of this file breaches copyright please contact [openaccess@ed.ac.uk](mailto:openaccess@ed.ac.uk) providing details, and we will remove access to the work immediately and investigate your claim.





## Review

# A systematic review and behaviour change technique analysis of remotely delivered alcohol and/or substance misuse interventions for adults

Neil Howlett<sup>a,\*</sup>, Jaime García-Iglesias<sup>a,1</sup>, Charis Bontoft<sup>a</sup>, Gavin Breslin<sup>b</sup>,  
Suzanne Bartington<sup>c</sup>, Imogen Freethy<sup>a</sup>, Monica Huerga-Malillos<sup>a</sup>, Julia Jones<sup>d</sup>, Nigel Lloyd<sup>a</sup>,  
Tony Marshall<sup>a</sup>, Stefanie Williams<sup>a</sup>, Wendy Wills<sup>d,1</sup>, Katherine Brown<sup>a,1</sup>

<sup>a</sup> Department of Psychology, Sport, and Geography, University of Hertfordshire, College Lane, Hatfield, Herts AL10 9AB, UK

<sup>b</sup> Bamford Centre for Mental Health and Wellbeing, School of Psychology, Ulster University, Cromore Road, Coleraine Co, Antrim BT52 1SA, UK

<sup>c</sup> Institute of Applied Health Research, University of Birmingham, Edgbaston, Birmingham B15 2TT, UK

<sup>d</sup> Centre for Research in Public Health and Community Care, University of Hertfordshire, College Lane, Hatfield, Herts AL10 9AB, UK



## ARTICLE INFO

## Keywords:

Alcohol misuse  
Substance misuse  
Remote delivery  
Behaviour change  
Behaviour change techniques  
Intervention promise

## ABSTRACT

**Background:** There has been a lack of systematic exploration of remotely delivered intervention content and their effectiveness for behaviour change outcomes. This review provides a synthesis of the behaviour change techniques (BCT) contained in remotely delivered alcohol and/or substance misuse approaches and their association with intervention promise.

**Methods:** Searches in MEDLINE, Scopus, PsycINFO (ProQuest), and the Cochrane Library, included studies reporting remote interventions focusing on alcohol and/or substance misuse among adults, with a primary behaviour change outcome (e.g., alcohol levels consumed). Assessment of risk of bias, study promise, and BCT coding was conducted. Synthesis focussed on the association of BCTs with intervention effectiveness using promise ratios.

**Results:** Studies targeted alcohol misuse (52 studies) or substance misuse (10 studies), with predominantly randomised controlled trial designs and asynchronous digital approaches. For alcohol misuse studies, 16 were very promising, 17 were quite promising, and 13 were not promising. Of the 36 eligible BCTs, 28 showed potential promise, with seven of these only appearing in very or quite promising studies. Particularly promising BCTs were 'Avoidance/reducing exposure to cues for behaviour', 'Pros and cons' and 'Self-monitoring of behaviour'. For substance misuse studies, three were very promising and six were quite promising, with all 12 BCTs showing potential promise.

**Conclusions:** This review showed remotely delivered alcohol and substance misuse interventions can be effective and highlighted a range of BCTs that showed promise for improving services. However, concerns with risk of bias and the potential of promise ratios to inflate effectiveness warrant caution in interpreting the evidence.

## 1. Introduction

Alcohol and substance misuse place a considerable burden on public health systems worldwide. Harmful alcohol use accounts for 5.1 % of the Global Burden of Disease (WHO, 2018a, 2020), and is believed to result in more than three million deaths per year globally (WHO, 2018b). In terms of substance misuse, in 2019 the World Health Organization estimated that 18 million years of healthy life were lost to drug use disorders (WHO, 2020), with annual rates of death from drug use

recently estimated at in excess of 500,000 (United Nations Office on Drugs and Crime, 2021). More generally, the misuse of illicit substances has been linked to short and long-term impacts on mental health (e.g., depression, self-harm, and suicide; Dick et al., 2019). The cost of a range of impacts to society from drug use in the UK alone, was estimated at over £ 19 billion (Black, 2020).

As internet access becomes more ubiquitous (Pew Research Center, 2017), smartphones or websites may increasingly support the delivery of treatments for alcohol and substance misuse (Ashford et al., 2019;

\* Corresponding author.

E-mail address: [n.howlett@herts.ac.uk](mailto:n.howlett@herts.ac.uk) (N. Howlett).

<sup>1</sup> These authors contributed equally to this work.

Bergman et al., 2018; Pew Research Center, 2017). Furthermore, literature reviews suggest that remote interventions may be as effective as face-to-face interventions (Kaner et al., 2017; NHS Digital, 2020) and may be particularly useful to engage with groups less likely to access face-to-face services (e.g., women or younger people; White et al., 2010). However, past reviews in this area have either looked at only one facet of remote delivery such as smartphone or limited versions of remote interventions where live synchronous interactions are not possible. For example, Dedert et al. (2015) looked at electronic interventions (e.g., online, mobile applications, or interactive voice response) for alcohol misuse and another review focused on interventions delivered through mobile technology only (Fowler et al., 2016). Reviews of substance misuse interventions have also had narrow focuses on internet and mobile-delivered interventions for misuse harm reduction (Dick et al., 2019) or prevention (Kazemi et al., 2017), or digital recovery support services (Ashford et al., 2019). Across all of these reviews the evidence base was preliminary in nature and effects were positive but small (e.g., reductions of one drink per week; Dedert et al., 2015). Adaptions to services during COVID-19, alongside advances in the quality and availability of video calling technology (e.g., Zoom or Teams), have provided the opportunity to test synchronous versions of face-to-face services that can provide ‘virtual care’ (i.e. comparable levels of interaction but remotely delivered; Coughlin et al., 2021). No review to date has explored whether the full range of remote delivery options being used by services can work.

Alongside knowing whether remote interventions are effective, it is equally important to know what intervention content is being utilised and how this relates to whether the approach works or not. Behaviour change techniques (BCTs) are the ‘active ingredients that bring about behaviour change’ (Michie et al., 2013, p. 82), and can be used to provide explicit detail on the content of any intervention that has a target behaviour as an outcome. The BCT taxonomy version 1 (Michie et al., 2013) includes 93 techniques which allow researchers and practitioners to describe and synthesize the range of components within interventions. BCTs can be related to study effectiveness with three different methods. If a meta-analysis is possible then BCTs can be input into a meta-regression to analyse whether they explain variation in effect sizes across studies (e.g., Michie et al., 2009). If a meta-analysis is not possible (due to heterogeneity in outcome, analysis methods, and/or statistics reported) then there are two further options. Firstly, promise ratios can be calculated for each BCT by comparing the number of very or quite promising studies with the number of not promising studies (Gardner et al., 2016). Secondly, an effectiveness ratio (or percentage) calculates the number of effective studies featuring a particular BCT compared with all of the studies featuring that BCT (Martin et al., 2013). A ratio of more than 2:1 indicates potential promise for a specific BCT using both of these methods. Each of these three methods attempt to analyse the effects that individual BCTs might be having on a behavioural outcome such as alcohol misuse, which can provide further evidence for the development or commissioning of services.

While some previous reviews on alcohol and substance misuse have coded BCTs, they have focussed on face-to-face delivery to specific groups, such as pregnant participants (Fergie et al., 2019; Gomez et al., 2020) or elective surgery patients (Budworth et al., 2019) and have not sought to explore how the highlighted BCTs are related to effectiveness. Reviews that have attempted to relate BCTs with effectiveness in alcohol and/or substance misuse studies have also either been in samples of pregnant women (Fergie et al., 2019) or have focused only on alcohol and a digital-only mode of delivery (i.e., a computer or mobile device; Garnett et al., 2018). Garnett et al. (2018) found that the BCTs ‘Behaviour substitution’, ‘Problem solving’, and ‘Credible source’ were associated with greater alcohol reduction. No systematic review to date has explored the BCTs used in any form of remotely delivered alcohol and substance misuse intervention and the relative promise of these BCTs.

This review is particularly timely, with the United Nations Office on

Drug and Crime yearly drug review, concluding that COVID-19 had led to significant and rapid innovation in prevention and treatment services, and recommended that scientific standards be updated to “keep abreast of the acceleration of internet-based services” (United Nations Office on Drug and Crime, 2021). The same report also suggested that the post-COVID-19 economic crisis may lead to an increase in drug use disorders. The COVID-19 pandemic and the public health measures implemented to control spread of the virus have caused significant alterations and led to many changes in the configuration and delivery of substance and alcohol services since early 2020. In some cases, this led to the cessation of face-to-face interventions and the transition to remote delivery. Research has established that already vulnerable communities have been disproportionately affected by these changes (Hall et al., 2020; Timothy, 2020). At the same time, these changes have provided a unique natural experimental opportunity to evaluate new models of remote delivery and content across services. Therefore, this review explores the BCTs included in remotely delivered substance and alcohol misuse interventions among adults and their associated promise.

### 1.1. Objectives

This review aimed to answer the following questions:

- What BCTs are contained within remotely delivered alcohol and substance misuse interventions?
- Which BCTs show promise in remotely delivered alcohol and substance misuse interventions?

## 2. Methods

Members of the Public Involvement in Research group (PIRg), part of the NIHR-funded PHIRST Connect, were involved in refining the review questions, eligibility criteria, adding accessibility (i.e., whether the ability of participants to access the remote elements was assessed) to the data extraction sheet, and contributing additional considerations for the context of the review. The Guidance for Reporting Involvement of Patients and the Public, Version 2 reporting checklist (Staniszewska et al., 2017) has been used alongside the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA; Page et al., 2021) and Synthesis without meta-analysis (SWiM; Campbell et al., 2020) reporting guidelines.

### 2.1. Eligibility criteria

Eligibility criteria for primary study inclusion were determined using the Population-Intervention-Comparator-Outcome-Study design criteria (PICOS; Amir-Behghadami and Janati, 2020). These were as follows:

#### 2.1.1. Population

To be included in this review, participants had to be 18 years of age or older and who qualified as experiencing alcohol and/or substance misuse. Alcohol and/or substance misuse was understood as potentially harmful use of alcohol or substances (including, illicit substances, psychoactive substances, novel psychoactive drugs, non-medical use of prescription medications, performance enhancement drugs, and other substances that may lead to substance misuse). Participants had to be screened for alcohol/substance use risk before inclusion and meet the following thresholds: for alcohol, a score of 8 or above on the Alcohol Use Disorders Identification Test (AUDIT; 3 or above on AUDIT-C; Haroon et al., 2018; Justice et al., 2018; Saunders et al., 1993). We also considered studies where the entry threshold was lower but the mean of the sample at baseline exceeded these scores. Studies containing alternative measures, such as Heavy Episodic Drinking (HED) were also considered. For cannabis, studies were included if they reported over half of participants with a Cannabis Use Disorder (CUD; Volkow et al., 2014), multiple cannabis-related problems and/or cannabis use on at

least half of the days in the last month. Alternative measures, such as a Drug Use Disorders Identification Test (DUDIT; Berman et al., 2005) score above eight, were also considered. Substance misuse was considered to also include the use of opiate or other medications when these had not been prescribed or were being used in excess of the prescribed dose.

### 2.1.2. Interventions

Interventions had to be delivered remotely and focus on alcohol and/or substance misuse support, harm reduction, and recovery. This review did not include interventions focused on tobacco or nicotine-based products. Remote interventions were defined as primarily delivered through computer or mobile devices (e.g., laptops or smart phones) and being specific to the service user (not readily available libraries of content). Interventions could be asynchronous or synchronous. Those interventions targeting multiple behaviours or conditions (e.g., mental health conditions) were included if the data related to alcohol and/or substance misuse was reported and discussed separately.

This review did not consider interventions whose remote elements were solely deployed to support face-to-face elements (e.g., online screenings and referral forms for subsequent face-to-face treatment, or online activities to be completed after face-to-face sessions). We also did not consider face-to-face interventions that were delivered remotely temporarily due to the service user's inability to access face-to-face services (e.g., temporary disability); nor did we consider interventions solely focused on preventing or reducing alcohol and/or substance use in people planning to get pregnant or already pregnant. Interventions delivered by post were also not included. We excluded studies where all or most participants were under 18 years-old, were not living freely in the community (e.g., hospital inpatients, prisoners), or were mandated to participate in the interventions.

### 2.1.3. Comparator groups

For intervention studies, we expected a wide range of comparators such as no intervention, service-as-usual care, face-to-face interventions, or hybrid interventions with significant remote and face-to-face components.

### 2.1.4. Outcomes

Outcomes from interventions could be measured using both objective methods and self-report. Primary outcomes were those which captured behaviour change related to alcohol and/or substance misuse at least at baseline and post-intervention. Secondary outcomes considered were: physical health outcomes (e.g. associated health conditions), mental health outcomes (e.g. depression), health inequality related data (e.g. subgroup analysis by Index of Deprivation score) or changes in alcohol and/or substance related outcomes (e.g. Accident & Emergency visits).

### 2.1.5. Study design

Included studies were randomised control trials (RCT), non-randomised control trials, quasi-randomised trials, and natural experimental studies (pre- and post- studies, interrupted time series studies).

## 2.2. Information sources

Searches were limited to peer reviewed published articles in English language available in: MEDLINE, Scopus, PsycINFO (ProQuest) and the Cochrane Library. No beginning year limit was imposed, and searches were run for evidence published until the end of November 2020. Additionally, the reference list of each included article was manually examined for further relevant articles (i.e., cited reference searching).

## 2.3. Search strategy

A sample strategy for PUBMED is available in the published protocol

(Howlett et al., 2021) and included the combination of MeSH terms and keywords used in line with PICOS. No restrictions were applied regarding date or publication type.

## 2.4. Selection process

The results from the literature searches were imported into the citation reference manager Mendeley and duplicates were removed. One author screened the title and abstract of all records for inclusion. A second author screened a random sample of 10 % of articles. Disagreements at the title-and-abstract stage were included for assessment in the next stage. After title-and-abstract screening, the full-text version of all included studies was reviewed independently by two authors, with a third author adjudicating disagreements. A record of reasons for exclusions can be seen in Fig. 1.

## 2.5. Data collection process

Due to potential variability between studies in terms of population, intervention, comparator, outcomes, design, and data type, the data extraction process was piloted with a sample of 10 % of the included studies, the data of which was extracted independently by two authors to a Microsoft Excel spreadsheet, with a third author moderating disagreements. Then, one author extracted the data from the remaining studies.

## 2.6. Data items

Data were extracted where available on general study information (e.g., duration of intervention, sample size), study population (e.g., demographics, inclusion criteria), intervention characteristics (e.g., theoretical basis, degree of personalisation), and study evaluation (e.g., outcome measures, follow-up).

## 2.7. BCT coding

All included studies and any related papers (e.g., protocols) were coded for Behaviour Change Techniques (BCT) using the BCT Taxonomy version 1 (Michie et al., 2013) by two authors separately. The first 10 % of studies were also coded independently by an additional author to check consistency and moderate the initial coding. This process was repeated with another 10 % of studies halfway through to ensure coding remained consistent.

## 2.8. Study risk of bias assessment

The Cochrane Risk of Bias (RoB 2; Sterne et al., 2019) tool was employed for RCTs, with the following five domains rated: Randomisation process; Deviations from intended interventions; Missing outcome data; Measurement of the outcome; Selection of the reported result. All five domains are rated as 'low risk', 'some concerns', or 'high risk', with the tool producing an overall rating. The Mixed Methods Appraisal Tool (MMAT; Hong et al., 2019) was utilised for non-randomised studies as it allows the potential to code qualitative, non-randomised, quantitative descriptive, and mixed methods studies. All studies are rated on five domains covering sampling, measurements, confounders, completeness of data, and analysis. Two coders independently rated all studies and if any disagreements remained after discussions a third reviewer was enlisted.

## 2.9. Effect measures

There was a high level of heterogeneity in primary outcome measures, analysis methods, and statistics reported across studies. Measures included alcohol units per day or week, frequency and percentage of heavy drinking days, blood alcohol concentration, number of days of

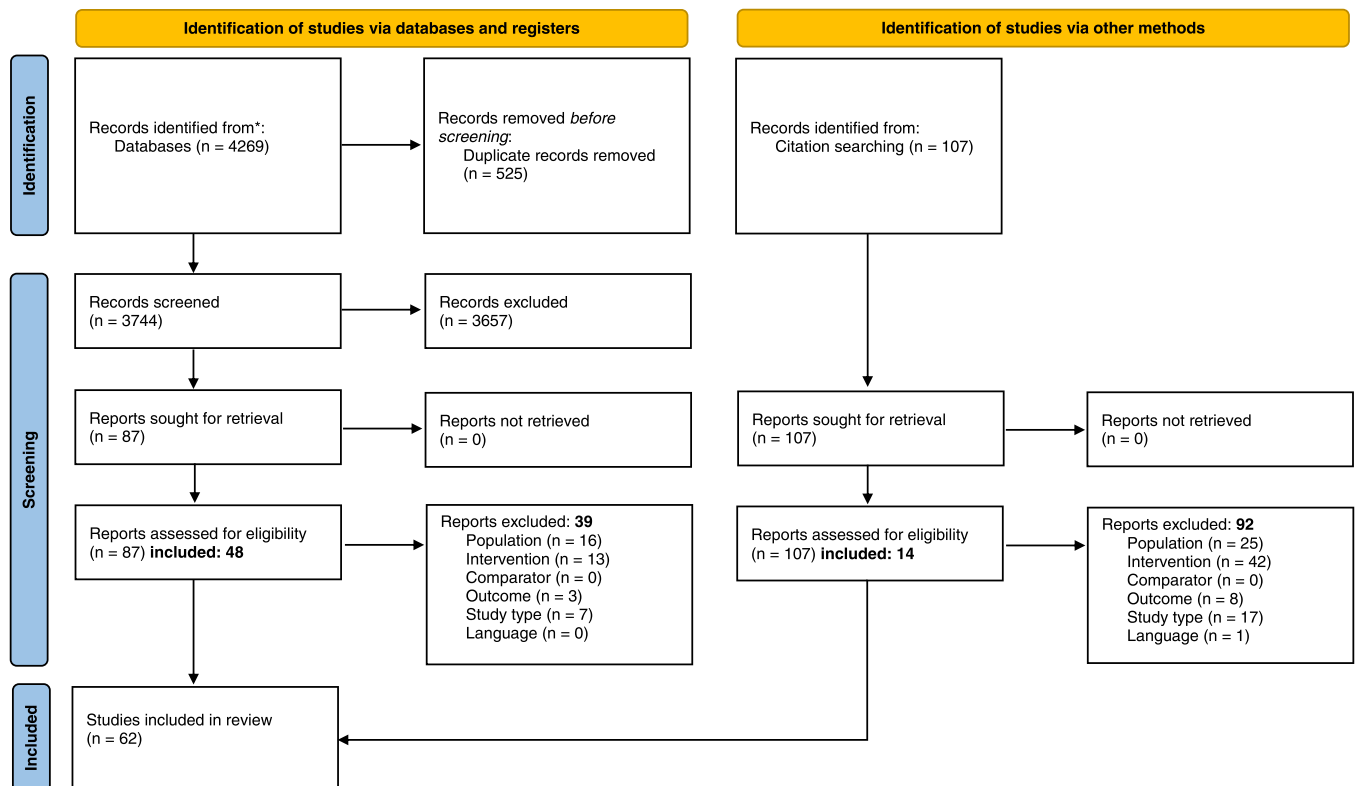


Fig. 1. PRISMA flowchart.

use, number of days since last use, number of substances used, or changes to AUDIT and DUDIT scores. Outcomes were presented as mean scores, medians, frequencies, or percentages. In addition to the heterogeneous outcomes, effect sizes and other key statistical detail (e.g., standard deviations) were not consistently reported.

### 2.10. Synthesis method

Given the wide range of outcomes and analysis methods across studies, this review includes a narrative analysis with the main focus being the assessment of promise ratios in the line with the published protocol (Howlett et al., 2021). Promise ratios are an established synthesis method used in a range of systematic reviews without meta-analysis (e.g., Hailey et al., 2022; Hallward et al., 2020; Nyman et al., 2018). Promise ratios were calculated for all studies with a comparator group, using the two-step method refined by Gardner et al. (2016). Firstly, the promise of each study was rated independently by two authors. A very promising rating was given when there was a statistically significant improvement in a primary outcome (alcohol or substance misuse) within the experimental group and the difference was significantly greater than the control group improvement (e.g., an interaction effect). A quite promising rating was given if there was either a statistically significant improvement within the experimental group or the between-subjects difference was significantly greater than the control group. Studies were rated as not promising where there was no statistically significant between or within-subjects difference. Secondly, promise ratios were calculated for each BCT across studies by dividing the number of (very or quite) promising interventions featuring the BCT by the number of non-promising interventions featuring the BCT. Promise ratios were calculated separately for alcohol and substance misuse interventions. BCTs were only analysed if they featured in at least two studies and were unique to the intervention arm (i.e., not also in the control arm and, therefore, if a study was promising this content could have driven the effect).

To examine the certainty of the findings, an additional check against stricter effectiveness criteria was conducted utilising analysis originally by Martin et al. (2013) by computing the number of very promising interventions featuring the BCT divided by the number of quite or non-promising interventions featuring the BCT. For both methods a minimum ratio threshold of 2:1 was considered promising. Furthermore, to test for the effect of studies that were judged as having high risk of bias, a sensitivity analysis was completed whereby the high-risk studies were removed from the promise ratio calculations. The data synthesis also included a summary of the types of remote delivery (e.g., website only, direct remote contact with therapist, synchronicity) and degree of personalization (e.g., personalized normative feedback, participant or intervention-directed goal setting, interactions with individual participants) that occurred.

## 3. Results

The results from the data extraction and synthesis were discussed with the PIRg, to 'sense-check' the findings from their lay perspective.

### 3.1. Study selection

After duplicates were removed 3851 studies were screened, primarily from database searches. At the full text stage, 194 studies were assessed for eligibility, with 62 studies included in the final review (see Fig. 1).

### 3.2. Study characteristics

The countries in which the 62 studies were conducted were diverse with the largest number from USA (21 studies, 34%), Australia (eight studies, 13%), Sweden (six studies, 10%), and the Netherlands (6 studies, 10%; see Supplementary Table 1 for full details). The behaviour targeted was alcohol misuse in 52 studies (84%) and substance misuse

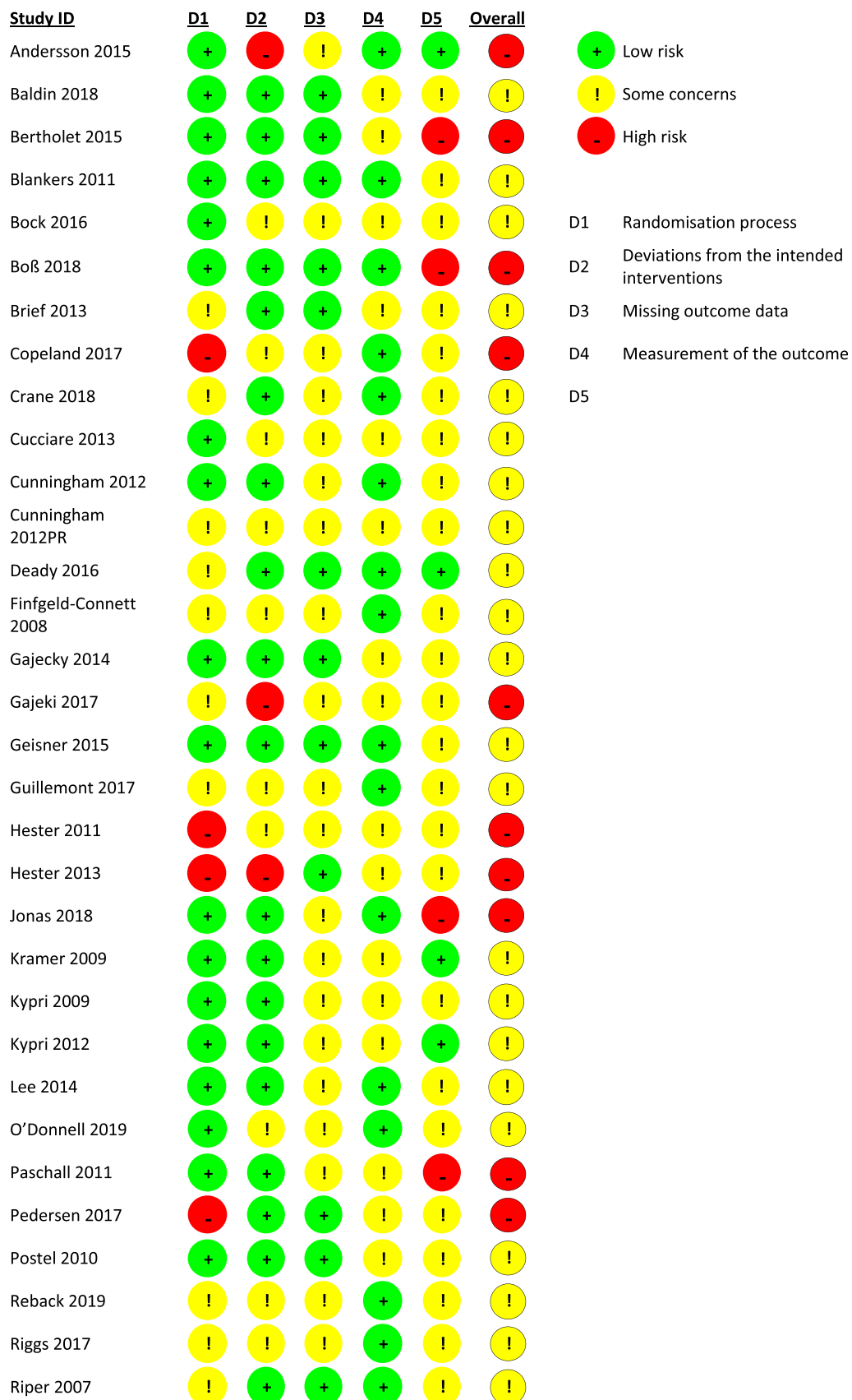


Fig. 2. Risk of bias summary.

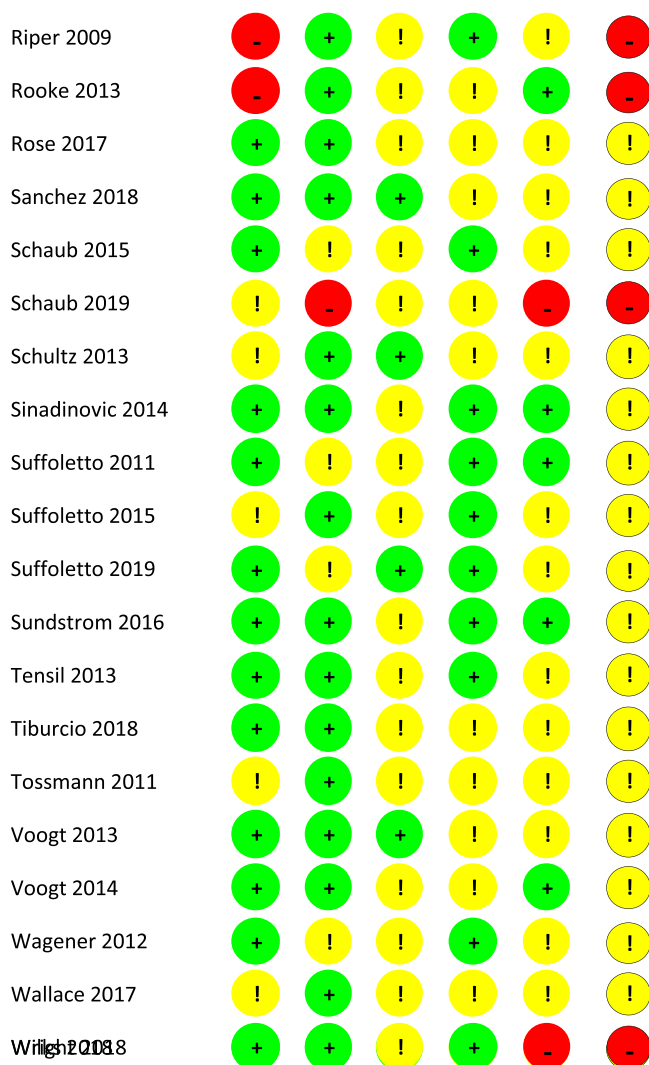


Fig. 2. (continued).

in 10 studies (16 %). Of the substance misuse studies, cannabis was targeted in six studies, with cocaine, methamphetamine, benzodiazepines, and a mix of substances targeted once each. An RCT design was used in 53 studies (85 %), with the remaining studies using non-randomised studies ( $k = 7$ , 11 %) or quantitative descriptive studies ( $k = 2, 3$  %).

The mode of delivery was predominantly website based (42/62 studies, 68 %), with the remaining studies using smartphone apps (eight studies, 13 %), text messages (six studies, 10 %), automated voice software (two studies, 3 %), or various combinations (full details in [Supplementary Table 1](#)). The majority of studies used asynchronous delivery (57/62 studies, 92 %). There were however four studies (6 %) using a mixture of asynchronous and synchronous features and one synchronous approach. Synchronous features tended to be live chat functions rather than video or phone conversations. Personalisation was mostly in the form of tailored feedback, goal setting, and risk information. The theoretical basis of intervention approaches was reported poorly overall. When reported the most common was cognitive behavioural, motivational interviewing or a combination of both, with the stages of change element of the Transtheoretical model, and the Theory of Planned Behaviour also utilised.

Average intervention duration was just over 9.5 weeks ranging from a single session up to one year. Only 32/62 studies (52 %) collected follow-up data, with an average duration of 20 weeks after the intervention was completed. The average reported age of participants was 33

years old with a fairly even gender split (47.5 % female), and an average baseline sample size per study of 698. Just over half of the studies captured secondary outcomes including: usability and satisfaction; accessibility; quality of life; readiness/stages of change; mood, anxiety, and/or depression; health, social, and legal consequences; emergency department data; self-efficacy; sleep quality.

### 3.3. Risk of bias

#### 3.3.1. Randomised controlled trials

All of the 53 RCTs had either some concerns ( $k = 39$ ) or were judged to have high risk of bias ( $k = 14$ ; for full breakdown see [Fig. 2](#)). The domain judged as having the lowest risk of bias was 'Deviations from intended interventions' (35/53 studies judged low risk) followed by 'Randomisation process' (31/53 studies judged low risk). A consistent issue with the 'Selection of the reported result' domain (9/53 studies judged low risk), was the lack of a detailed pre-specified analysis plan in either a trial registry or published protocol. The risk of bias domains judged to have the most high-risk studies were 'Randomisation process' (6/53 studies judged low risk) and 'Selection of the reported result' domain (6/53 studies judged high risk). The main problems with the missing outcome data (38/53 studies judged as having some concerns) and measurement of outcome (27/53 studies judged as having some concerns) domains were relatively high dropout rates and the self-report nature of substance misuse measures (precluding blinding of assessor)

respectively.

### 3.3.2. Non-RCT designs

The non-RCT studies contained in this review were either non-randomised studies such as single group quasi-experimental designs, or quantitative descriptive studies. For non-randomised designs, participants were judged to be representative of the target population and the intervention was judged to have been administered as intended for all studies ( $k = 7$ ). There was however missing data and lack of accounting for confounders at times (see full ratings in [Supplementary Table 2](#)). For the two quantitative descriptive studies, measures were deemed appropriate, but there were issues with inappropriate analysis plans (e.g., lack of adjustment for missing data) and sample representativeness (e.g., the sample may not have been representative of the target population).

### 3.4. Results of synthesis

#### 3.4.1. Promise ratings

Overall, 19 studies (34%) were rated as very promising, 23 studies (42 %) as quite promising, and 13 studies (24 %) as not promising (see [Table 1](#) for full ratings). The seven studies utilising single group pre-post designs were not included in the promise ratings calculations as a very promising rating was not possible.

#### 3.4.2. Behaviour change techniques

In studies targeting alcohol misuse a total of 45 BCTs were used in at least one study, and 36 BCTs used in at least two studies. The most prevalent BCTs were ‘Feedback on behaviour’ ( $k = 27$ ), ‘Problem solving’ ( $k = 25$ ), and ‘Goal setting (behaviour)’ ( $k = 23$ ) (see [Supplementary Table 1](#) for full breakdown). The number of BCTs unique to the intervention group reported in individual studies ranged from 2 to 18, with a mean of 7.4 BCTs per study. In studies targeting substance misuse a total of 30 BCTs were used in at least one study, and 12 BCTs used in at least two studies. The most prevalent BCTs were ‘Feedback on behaviour’ ( $k = 6$ ), ‘Problem solving’ ( $k = 5$ ), ‘Self-monitoring of behaviour’ ( $k = 5$ ), and ‘Goal setting (behaviour)’ ( $k = 5$ ). The number of BCTs unique to the intervention group reported in individual studies ranged from 0 to 13, with a mean of 6.1 BCTs per study.

#### 3.4.3. Promise ratios

For studies targeting alcohol misuse, 16 (35 %) were very promising, 17 (37 %) were quite promising, and 13 (28 %) were not promising studies. Of the 36 BCTs that were used in at least two studies and unique to the intervention condition, 28 showed potential promise, with seven of these only appearing in very or quite promising studies. Therefore, although a ratio could not be calculated, these could be particularly promising BCTs. For example, ‘Reduce negative emotions’ appeared in 11 studies all showing some level of promise.

Particularly promising BCTs were ‘Avoidance/reducing exposure to cues for behaviour’ – 7:1 promise ratio; ‘Pros and cons’ – 6.5:1 promise ratio; and ‘Self-monitoring of behaviour’ – 4.3:1 promise ratio [Fig. 3](#). Using the stricter criteria of only very promising studies associated with BCTs, all of the promise ratios dropped below the threshold of 2:1 apart from ‘Restructuring the social environment’ – 4:1 promise ratio, ‘Social support (emotional)’ – 3:1 promise ratio, and ‘Review behaviour goals’ – 2:1 promise ratio.

For studies targeting substance misuse, three (33 %) were very promising and six (67 %) were quite promising. Of the 12 BCTs that were used in at least two studies, all showed potential promise. Using the stricter criteria of only very promising studies associated with BCTs, all of the promise ratios dropped below the threshold of 2:1 apart from ‘Social support (unspecified)’ – 2:1 promise ratio [Table 3](#).

#### 3.4.4. Sensitivity analysis

A sensitivity analysis was conducted to explore the effect of

**Table 1**

Promise ratings for all studies with a comparator group.

Study	Very promising (n = 19)	Quite promising (n = 23)	Not promising (n = 13)
Andersson (2015)	X		
Andrade et al. (2016)			X
Baldin et al. (2018)		X	
Bertholet et al. (2015)	X		
Blankers et al. (2011)	X		
Bock et al. (2016)		X	
Boß et al. (2018)	X		
Brief et al. (2013)	X		
Copeland et al. (2017)*		X	
Crane et al. (2018) <sup>a</sup>			X
Cucciare et al. (2013)		X	
Cunningham (2012)		X	
Cunningham (2012) - PRT			X
Deady et al. (2016)		X	
Finfgeld-Connett, Madsen (2008)		X	
Gajeccki et al. (2014)			X
Gajeccki et al. (2017)		X	
Geisner et al. (2015)			X
Gonzalez, Dulin (2015)		X	
Guillemont et al. (2017)	X		
Hester et al. (2011)		X	
Hester et al. (2013)		X	
Jonas et al. (2018)*		X	
Kramer et al. (2009)	X		
Kypri et al. (2009)	X		
Kypri et al. (2013)	X		
Lee et al. (2014)			X
O'Donnell et al. (2019)			X
Paschall et al. (2011)		X	
Pedersen et al. (2017)	X		
Postel (2010)	X		
Reback et al. (2019)*		X	
Riggs et al. (2018)*	X		
Riper et al. (2008)	X		
Riper et al. (2009)	X		
Rooke et al. (2013)*	X		
Rose et al. (2017)		X	
Sanchez, Sanudo (2018)		X	
Schaub et al. (2015)*	X		
Schaub et al. (2019)*		X	
Schulz et al. (2013)			X
Sinadinovic et al. (2014)		X	
Suffoletto et al. (2012)	X		
Suffoletto et al. (2014)		X	
Suffoletto et al. (2019)			X
Sundström et al. (2016)	X		
Tensil et al. (2013)		X	
Tiburcio et al. (2018)*		X	
Tossmann et al. (2011)		X	
* Voogt et al. (2013)			X
Voogt et al. (2014)			X
Wagener et al. (2012)			X
Wallace et al. (2017)		X	
Wilks et al. (2018)	X		
Wright et al. (2018)			X

Note: \*signifies a substance misuse study (rather than alcohol); <sup>a</sup>signifies that this study can be given a promise rating but was not included in the promise ratio calculations as all intervention arms represented a BCT.

removing high risk studies from the promise ratio calculations (Full results can be found in [Supplementary Tables 3 and 4](#)). For studies targeting alcohol misuse, 11 (31 %) were very promising, 13 (37 %) were quite promising, and 11 (31 %) were not promising studies. Of the 34 BCTs, 26 showed potential promise, with eight of these only appearing in very or quite promising studies. Particularly promising BCTs were still ‘Self-monitoring of behaviour’ – 7:1 promise ratio.



**Table 2**  
Behaviour change techniques and intervention promise for studies targeting reductions in alcohol misuse.

Behaviour change technique	Very Promising (n = 16)	Quite promising (n = 17)	Not promising (n = 13)	All studies (n = 46)	Promise Ratio	Very promising ratio
1.1 Goal setting (behaviour)	10	8	5	23	<b>3.6</b>	0.8
1.2 problem solving	8	12	5	25	<b>4</b>	0.5
1.3 Goal setting (outcome)	0	1	2	3	0.5	0
1.4 Action planning	6	1	4	11	1.8	1.2
1.5 Review behaviour goals*	2	0	0	2		<b>2</b>
1.6 Discrepancy between current behaviour and goal	1	1	2	4	1	0.3
1.9 Commitment	1	1	1	3	<b>2</b>	0.5
2.2 Feedback on behaviour	10	7	10	27	1.7	0.6
2.3 Self-monitoring of behaviour	9	8	4	21	<b>4.3</b>	0.8
2.4 Self-monitoring of outcomes	1	1	3	5	0.7	0.3
2.6 Biofeedback	0	2	1	3	<b>2</b>	0
2.7 Feedback on outcome of behaviour	4	7	5	16	<b>2.2</b>	0.3
3.1 Social support (unspecified)	9	6	5	20	<b>3</b>	0.8
3.3 Social support (emotional)	3	0	1	4	<b>3</b>	<b>3</b>
4.1 Instruction on how to perform a behaviour	5	5	3	13	<b>3.3</b>	0.6
4.2 Information about Antecedents	5	6	3	14	<b>3.7</b>	0.6
5.1 Information about health consequences	4	5	3	12	<b>3</b>	0.5
5.2 Salience of consequences	2	1	2	5	1.5	0.7
5.3 Information about social and environmental consequences	5	6	5	16	<b>2.2</b>	0.5
5.4 Monitoring of emotional consequences	0	0	2	2	0	0
5.6 Information about emotional consequences	1	2	2	5	1.5	0.3
6.2 Social comparison	8	4	6	18	<b>2</b>	0.8
7.1 Prompts and cues	2	5	2	9	<b>3.5</b>	0.3
8.1 Behaviour practice/rehearsal	2	1	1	4	<b>3</b>	1
8.2 Behaviour substitution	1	3	1	5	<b>4</b>	0.3
9.1 Credible source*	3	0	0	3		
9.2 Pros and Cons	7	6	2	15	<b>6.5</b>	0.9
9.3 Comparative imagining of future outcomes*	1	1	0	2		1
10.9 Self-reward*	0	3	0	3		0
11.2 Reduce negative emotions*	3	8	0	11		0.4
12.2 Restructuring the social environment	4	0	1	5	<b>4</b>	<b>4</b>
12.3 Avoidance/reducing exposure to cues for behaviour	4	3	1	8	<b>7</b>	1
12.4 Distraction	1	1	1	3	<b>2</b>	0.3
12.6 Body changes*	1	3	0	4		0.3
13.2 Framing/reframing*	1	2	0	3		0.3
15.3 Focus on past success*	0	2	0	2		0

Note: \*Techniques were used only in promising interventions.

Potentially promising BCTs highlighted in bold.

Promise ratio calculation = Very + quite promising/not promising

Very promising ratio calculation = Very promising/quite + not promising

One 'not promising' study was not eligible due to each intervention arm being an individual BCT (Crane, 2018)

'Avoidance/reducing exposure to cues for behaviour' – 5:1 promise ratio; and 'Pros and cons' – 5:1 promise ratio. Using the stricter criteria of only very promising studies associated with BCTs, the original three BCTs remained promising in addition to two others, 'Behaviour practice/rehearsal' – 2:1 promise ratio; and 'Credible source' – 2:1 promise ratio.

For studies targeting substance misuse, two were very promising and three were quite promising. Of the 6 BCTs, all showed potential promise. Using the stricter criteria of only very promising studies associated with BCTs, 'Problem Solving' – 2:1 promise ratio and 'Self-monitoring of behaviour' – 2:1 promise ratio, remained promising.

## 4. Discussion

### 4.1. General interpretation

This review aimed to explore the BCTs contained in remotely delivered alcohol and/or substance misuse approaches and then examine the association between BCTs and intervention promise. A range of BCTs were present across studies, with 'Feedback on Behaviour', 'Problem Solving', and 'Goal Setting (behaviour)' featuring most frequently for both alcohol and substance misuse interventions. 'Goal setting (behaviour)' and 'Problem Solving' have been used frequently in

studies targeting alcohol and or substance misuse in reviews featuring participants during pregnancy or motherhood (Fergie et al., 2019; Gomez et al., 2020). The included studies covered mostly website-based interventions, with asynchronous features. Where synchronous features were present, this included messaging with a therapist or peer health educator, or chat functions with a researcher or other participants. The majority of included studies targeting alcohol and all of the substance misuse studies showed some promise in improving outcomes. However, only one third of studies targeting either behaviour was effective in traditional trial terms (more effective than the control group over time).

There were a large number of potentially promising BCTs for each behaviour, with a more conservative criterion shrinking this number considerably. Particularly promising BCTs for alcohol were 'Avoidance/reducing exposure to cues for behaviour', 'Pros and cons' and 'Self-monitoring of behaviour'. An example of 'Avoidance/reducing exposure to cues for behaviour' would be to find alternative venues, spaces, or activities in which to spend leisure time. 'Pros and Cons' involves listing and comparing the advantages and disadvantages of quitting alcohol (and to ideally help the person to decide that quitting alcohol is more advantageous than continuing with current consumption levels). 'Self-monitoring of behaviour' involves recording daily consumption of alcohol. It must also be noted that the BCT 'Reduce negative emotions' appeared in 11 studies, all of which were potentially promising. A

### Promise ratio for each BCT

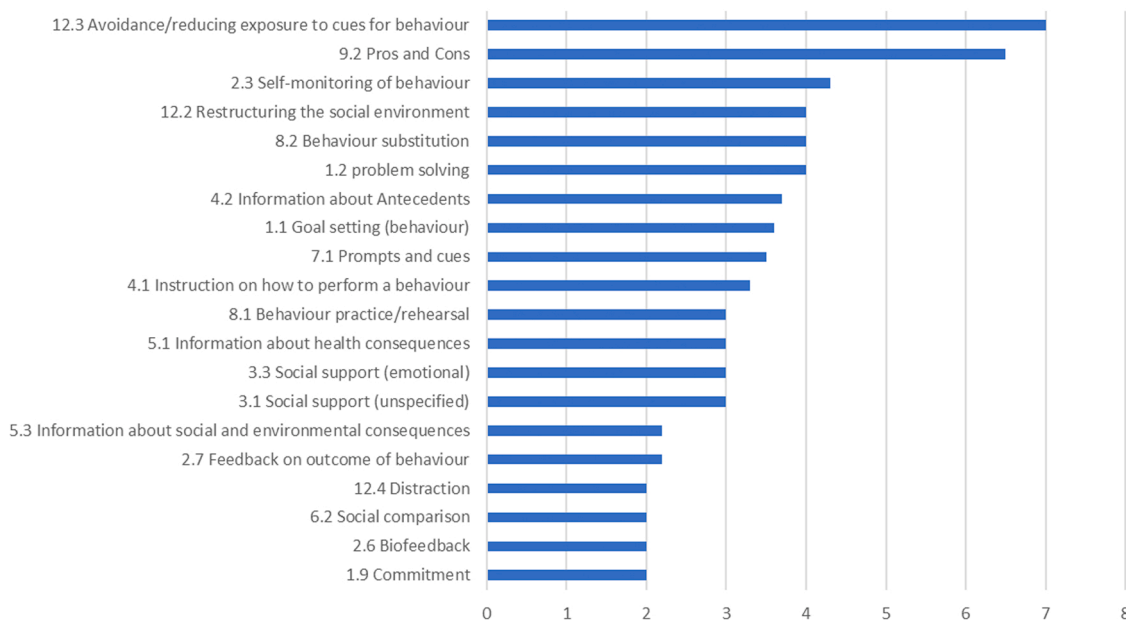


Fig. 3. Summary of promise ratios by BCTs in descending order of promise for alcohol studies.

Table 3

Behaviour change techniques and intervention promise for studies targeting reductions in substance misuse.

Behaviour change technique	Very Promising (n = 3)	Quite promising (n = 6)	Not promising (n = 0)	All (n = 9)	Promise Ratio	Very promising ratio
1.1 Goal setting (behaviour)*	2	3	0	5		1
1.2 problem solving*	3	2	0	5		1.5
1.5 Review behaviour goal(s)*	1	1	0	2		1
2.2 Feedback on behaviour*	2	4	0	6		0.5
2.3 Self-monitoring of behaviour*	3	2	0	5		1.5
2.7 Feedback on outcome of behaviour*	1	1	0	2		1
3.1 Social support (unspecified) *	2	1	0	3		2
4.2 Information about Antecedents*	1	1	0	2		1
5.1 Information about health consequences*	1	1	0	2		1
6.2 Social comparison*	1	1	0	2		1
9.2 Pros and Cons*	1	2	0	3		0.5
13.2 Framing/ reframing*	1	1	0	2		1

Note: \*Techniques were used only in promising interventions.

Promise ratio calculation = Very + quite promising/not promising.

Very promising ratio calculation = Very promising/quite + not promising.

previous review of digital alcohol interventions highlighted the BCTs ‘Behaviour substitution’, ‘Problem solving’, and ‘Credible source’ as associated with greater alcohol reduction (Garnett et al., 2018), which is consistent with the findings in this review, with all three of these BCTs showing promise for reducing alcohol misuse. Alcohol service providers are encouraged to review whether these approaches are already in use and adapt their practice to include the most promising techniques.

#### 4.2. Limitations of evidence included

The intention of this review was to synthesise remotely delivered interventions for alcohol and substance misuse, with the potential to inform research, practice, and commissioning in relation to the adaptations made since COVID-19. This review did not find any studies that explored the effect of remote synchronous methods such as video calling, which would have provided relevant evidence for adaptations made to drug and alcohol support services during COVID-19. The studies included were predominantly website based and asynchronous, rather than service provision. Furthermore, most studies were rated as having

some concerns or high risk of bias, so caution must be applied in interpreting the body of evidence presented. However, a sensitivity analysis with high-risk studies removed showed findings consistent with the overall results. Previous reviews in this area have had similar issues with moderate to high risk of bias (Dedert et al., 2015) and weak study quality due to minimal blinding of participants and researchers, and self-reported measures (Dick et al., 2019; Kazemi et al., 2017). Many traditional trial approaches were reported clearly (e.g., randomisation and allocation procedures), but the nature of behaviour change interventions necessitates that a lack of blinding in terms of deliverers and outcomes (e.g., with self-report measures the participant is the assessor) precludes a low rating overall. One area that was a particular problem was a lack of detailed protocols. Most studies were recorded in a trial registry, but this contained minimal information, particularly related to outcomes and analysis plan.

Effect sizes were rarely reported, which prevented the review from highlighting whether changes in outcomes were clinically as well as statistically significant. Only half of the studies attempted to collect long-term follow-up to assess behaviour change maintenance. This may

have inflated the 'promise' of the studies as a consistent finding in interventions targeting other health behaviours is that effects become smaller over time with no intervention contact (e.g., Howlett et al., 2019). On a related note, there was a lack of process evaluations nested within the interventions, which would have helped ascertain the acceptability of these approaches, and whether synchronous elements of the interventions were delivered as intended. Similarly, there was a dearth of studies exploring health inequalities, particularly with digital health approaches, where digital exclusion could have a real impact on who can access the interventions, and risks further exacerbating existing disparities in health outcomes (Serafino, 2019).

#### 4.3. Limitations of review process

This review searched a limited number of databases and only selected English language studies to manage capacity to undertake the review. It is possible that some relevant studies may have been missed, although a large number of studies were screened and included. Furthermore, included studies were all conducted in North America, Europe, or Australia, so this review cannot comment on complementary or alternative approaches in other regions. The search terms were also designed around the PICOS framework, and were therefore, orientated towards quantitative studies, even though the initial intention was to cover all study types. Subsequently, it was not possible to answer the research question from the protocol around the experiences of service providers and users of alcohol and substance misuse services. In future, it would be best to conduct separate reviews for such diverse study designs (e.g., Brown et al., 2019, 2020). Furthermore, the review attempted to develop a consistent definition of 'misuse' across a range of substances, but it might be better in future reviews to divide substance misuse into more specific categories. Lastly, due to a high degree of heterogeneity in outcomes, analysis, and statistics reported, a meta-analysis was not possible, precluding us from commenting on the strength of effects across study or potential publication biases.

#### 4.4. Implications for practice, policy, future work

The changes that have been made, and continue to persist, in relation to COVID-19 have been a catalyst for adaptations to alcohol and substance misuse treatment services. This review did not capture findings that could lead to explicit recommendations for best practice going forward for remote service delivery. We recommend that future research examines the effects of remote service delivery utilising video technology (such as Zoom) and telephone-based support. In the next 5–10 years, it would then be possible to revisit this topic with a systematic review to more fully answer this question. In the future, we also call for more routine assessment of behaviour change maintenance and improved reporting of study methodology and outcomes. It is essential for public health stakeholders to know that money spent on these programmes will have lasting effects beyond the more intensive initial stages. Nested process evaluations would also allow stakeholders to know how the programme worked (or not), including acceptability for the target population.

While coding the risk of bias for RCTs, two observations were made that may be relevant for rating other types of behaviour change interventions. Firstly, outcome measures are often self-report (i.e., unblinded assessment) and dropout of participants is usually relatively high (i.e., missing outcome data), meaning that it is very hard for studies to be rated as low risk on the third and fourth domains (and therefore overall). In the case of alcohol and substance misuse studies, the incidence of missing data may reflect the relatively high drug and alcohol treatment non-completion rate (e.g., 33 % in England in 2020/21, Office for National Statistics). As these interventions are often being tested in real-world service provision, it may be appropriate to have more pragmatic criteria for rating risk of bias going forward. Secondly, a key improvement that these types of studies could make is to provide more

detailed pre-registered protocols, particularly related to outcomes and analysis plan. The lack of detail provided often made it impossible to tell whether analysis was undertaken as planned.

The last consideration is around the use of promise ratios, which can potentially inflate the effect of individual BCTs. This was a particular concern in this review where a majority of studies were rated as quite promising because of improvements over time in the intervention group only. Stricter effectiveness criteria may be needed going forward, at least as a comparison, to drill into the most effective techniques where the evidence is mixed.

A key strength of this review was the active involvement of the Public Involvement in Research group (PIRG), which is an integral part of the NIHR-funded PHIRST Connect based at the University of Hertfordshire. Members of the PIRg were actively involved in different stages of the review process, including refining the review questions, eligibility criteria, data synthesis, and the dissemination strategy.

## 5. Conclusion

Overall, this review showed that a large number of interventions targeting alcohol misuse can be potentially promising in the short term and highlighted a range of BCTs that showed promise in improving outcomes. The smaller collection of studies targeting substance misuse also showed promise, with all of the interventions having some positive effect. The BCTs highlighted as most promising should help guide a range of stakeholders who fund and deliver services to include this content in service provision so that they have the greatest chance of success. Future research needs to examine the effects of synchronous remote delivery via video and/or telephone, and include detailed pre-registration and more robust process evaluation, with the measurement of behaviour change maintenance a priority.

## Funding

This work is part of the NIHR-funded Project "New models of remote delivery, in drug and alcohol services, introduced during Covid-19" (Award number: NIHR133206), conducted by the PHIRST (Public Health Intervention Responsive Studies Team) funded by NIHR Public Health Research funding stream (Award number: NIHR131573). WW is also part funded by the NIHR Applied Research Collaboration for the east of England. The views expressed are those of the authors and not necessarily those of the NIHR or the Department of Health and Social Care. The funders have not had a role in study design, data collection and analysis, decision to publish, or preparation of the manuscript.

## Data availability

All data is contained within table, figures, and supplementary files.

## Registration

This review was registered in PROSPERO (CRD42021234116) and a full protocol has been published (Howlett et al., 2021).

## CRediT authorship contribution statement

All authors made significant intellectual contributions to the study. NH, JG-I, GB, SB, JJ, NL, KB, and WW led on conceptualisation and design of the study. JG-I and NH led on database searches. NH, JG-I, GB, and SB led on title, abstract, and full text screening. NH, JG-I, MH, TM, SB, and SW led on data extraction and risk of bias/MMAT coding. NH, CB, IF, KB, and SW led on promise ratings and BCT coding. NH and SW led on data synthesis. JJ, JG-I, and NH led on public involvement input. NH led on drafting the manuscript and all authors reviewed and contributed to manuscript drafts; all authors have read the final version of the manuscript and approved it for publication.

## Conflict of interest

The authors have declared that no conflicts of interest exist.

## Acknowledgements

The authors wish to thank all members of the PHIRST Connect research team, and the PHIRST Connect Public Involvement in Research group (PIRG), for their valued contributions to this paper.

## Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at [doi:10.1016/j.drugalcdep.2022.109597](https://doi.org/10.1016/j.drugalcdep.2022.109597).

## References

- Amir-Behghadami, M., Janati, A., 2020. Population, Intervention, Comparison, Outcomes and Study (PICOS) design as a framework to formulate eligibility criteria in systematic reviews. *Emergency Medicine Journal*. <https://doi.org/10.1136/emmed-2020-209567>.
- Andersson, C., 2015. Comparison of WEB and Interactive Voice Response (IVR) methods for delivering brief alcohol interventions to hazardous-drinking university students: a randomized controlled trial. *European Addiction Research* 21 (5), 240–252. <https://doi.org/10.1159/000381017>.
- Andrade, A.L.M., de Lacerda, R.B., Gomide, H.P., Ronzani, T.M., Sartes, L.M.A., Martins, L.F., Bedendo, A., Souza-Formigoni, M., L., O., 2016. Web-based self-help intervention reduces alcohol consumption in both heavy drinking and dependent alcohol users: a pilot study. *Addict. Behav.* 63, 63–71.
- Ashford, R.D., Brandon, G.B., John, F.K., Brenda, C., 2019. Systematic review: digital recovery support services used to support substance use disorder recovery. *Hum. Behav. Emerg. Technol.* 2 (1), 18–32. <https://doi.org/10.1002/hbe2.148>.
- Baldin, Y.C., Sanudo, A., Sanchez, Z.M., 2018. Effectiveness of a web-based intervention in reducing binge drinking among nightclub patrons. *Rev. Saude Publica* 52, 2.
- Bergman, B.G., Greene, M.C., Hoepfner, B.B., Kelly, J.F., 2018. Expanding the reach of alcohol and other drug services: prevalence and correlates of US adult engagement with online technology to address substance problems. *Addict. Behav.* 87, 74–81. <https://doi.org/10.1016/j.addbeh.2018.06.018>.
- Berman, A.H., Bergman, H., Palmstierna, T., Schlyter, F., 2005. Drug Use Disorders Identification Test (DUDIT). European Monitoring Centre for Drugs and Drug Addiction Document Library. Available at: ([https://www.emcdda.europa.eu/drugs-library/drug-use-disorders-identification-test-dudit\\_en#additionallinfo](https://www.emcdda.europa.eu/drugs-library/drug-use-disorders-identification-test-dudit_en#additionallinfo)).
- Bertholet, N., Cunningham, J.A., Faouzi, M., Gaume, J., Gmel, G., Burnand, B., Daeppen, J.-B., 2015. Internet-based brief intervention for young men with unhealthy alcohol use: a randomized controlled trial in a general population sample. *Addiction* 110 (11), 1735–1743.
- Black, C. Review of drugs: phase one report, 2020. Available at: (<https://www.gov.uk/government/publications/review-of-drugs-phase-one-report>).
- Blankers, M., Koeter, M.W.J., Schippers, G.M., 2011. Internet therapy versus internet self-help versus no treatment for problematic alcohol use: a randomized controlled trial. *J. Consult Clin. Psychol.* 79 (3), 330.
- Bock, B.C., Barnett, N.P., Thind, H., Rosen, R., Walaska, K., Traficante, R., Foster, R., Deutsch, C., Fava, J.L., Scott-Sheldon, L.A.J., 2016. A text message intervention for alcohol risk reduction among community college students: TMAP. *Addict. Behav.* 63, 107–113.
- Boß, L., Lehr, D., Schaub, M.P., Paz Castro, R., Riper, H., Berking, M., Elbert, D.D., 2018. Efficacy of a web-based intervention with and without guidance for employees with risky drinking: results of a three-arm randomized controlled trial. *Addiction* 113 (4), 635–646.
- Brief, D.J., Rubin, A., Keane, T.M., Enggasser, J.L., Roy, M., Helmuth, E., Hermos, J., Lachowicz, M., Rybin, D., Rosenbloom, D., 2013. Web intervention for OEF/OIF veterans with problem drinking and PTSD symptoms: a randomized clinical trial. *J. Consult Clin. Psychol.* 81 (5), 890–900.
- Brown, S.J., Khataganan, N., Brown, K., Hegarty, K., Carter, G.J., Tarzia, L., Feder, G., O'Doherty, L., 2019. Psychosocial interventions for survivors of rape and sexual assault experienced during adulthood. *Cochrane Database Syst. Rev.* 11.
- Brown, S.J., Khataganan, N., Carter, G.J., Brown, K., Caswell, R.J., Howarth, E., Feder, G., O'Doherty, L., 2020. Survivor, family and professional experiences of psychosocial interventions for sexual abuse and violence: a qualitative evidence synthesis. *Cochrane Database Syst. Rev.*
- Budworth, L., Prestwich, A., Lawton, R., Kotzé, A., Kellar, I., 2019. Preoperative interventions for alcohol and other recreational substance use: a systematic review and meta-analysis. *Front Psychol.* 10 (34) <https://doi.org/10.3389/fpsyg.2019.00034>.
- Campbell, M., McKenzie, J.E., Sowden, A., Katikireddi, S.V., Brennan, S.E., Ellis, S., Hartmann Boyce, J., Ryan, R., Sheppard, S., Thomas, J., Welch, V., Thomson, H., 2020. Synthesis without meta-analysis (SWiM) in systematic reviews: reporting guideline. *BMJ* 368, l6890. <https://doi.org/10.1136/bmj.l6890>.
- Copeland, J., Rooke, S., Rodriguez, D., Norberg, M.M., Gibson, L., 2017. Comparison of brief versus extended personalised feedback in an online intervention for cannabis users: short-term findings of a randomised trial. *J. Subst. Abus. Treat.* 1 (76), 43–48.
- Coughlin, L.N., Bonar, E.E., Bickel, W.K., 2021. Considerations for remote delivery of behavioral economic interventions for substance use disorder during COVID-19 and beyond. *J. Subst. Abus. Treat.* 120, 108150 <https://doi.org/10.1016/j.jst.2020.108150>.
- Crane, D., Garnett, C., Michie, S., West, R., Brown, J., 2018. A smartphone app to reduce excessive alcohol consumption: identifying the effectiveness of intervention components in a factorial randomised control trial. *Sci. Rep.* 8 (1), 1–11.
- Cucciare, M.A., Weingardt, K.R., Ghaus, S., Boden, M.T., Frayne, S.M., 2013. A randomized controlled trial of a web-delivered brief alcohol intervention in Veterans Affairs primary care. *J. Stud. Alcohol Drugs* 74 (3), 428–436.
- Cunningham, J.A., 2012. Comparison of two internet-based interventions for problem drinkers: randomized controlled trial. *J. Med. Internet Res.* 14 (4), e107.
- Deady, M., Mills, K.L., Teesson, M., Kay-Lambkin, F., 2016. An online intervention for co-occurring depression and problematic alcohol use in young people: primary outcomes from a randomized controlled trial. *J. Med. Internet Res.* 18 (3), e71.
- Dedert, E., A., McDuffie, J.R., Stein, R., McNeil, J.M., Kosinski, A.S., Freiermuth, C.E., Hemminger, A., Williams Jr, A.W., 2015. Electronic interventions for alcohol misuse and alcohol use disorders: a systematic review. *Ann. Intern. Med.* 163 (3), 205–214. <https://doi.org/10.7326/M15-0285>.
- Dick, S., Whelan, E., Davoren, M.P., Dockray, S., Heavin, C., Linehan, C., Byrne, M.A., 2019. Systematic review of the effectiveness of digital interventions for illicit substance misuse harm reduction in third-level students. *BMC Public Health* 19. <https://doi.org/10.1186/s12889-019-7583-6>.
- Fergie, L., Campbell, K.A., Coleman-Haynes, T., Ussher, M., Cooper, S., Coleman, T., 2019. Identifying effective behavior change techniques for alcohol and illicit substance use during pregnancy: a systematic review. *Ann. Behav. Med.* 53 (8), 769–781. <https://doi.org/10.1093/abm/kay085>.
- Fingeld-Connett, D., Madsen, R., 2008. Web-based treatment of alcohol problems among rural women. *J. Psychosoc. Nurs. Ment. Health Serv. [Internet]* 46 (9), 46–53.
- Fowler, L.A., Holt, S.L., Joshi, D., 2016. Mobile technology-based interventions for adult users of alcohol: a systematic review of the literature. *Addict. Behav.* 62, 25–34. <https://doi.org/10.1016/j.addbeh.2016.06.008>.
- Gajeci, M., Berman, A.H., Sinadinovic, K., Rosendahl, I., Andersson, C., 2014. Mobile phone brief intervention applications for risky alcohol use among university students: a randomized controlled study. *Addict. Sci. Clin. Pr.* 9 (1), 11.
- Gajeci, M., Andersson, C., Rosendahl, I., Sinadinovic, K., Fredriksson, M., Berman, A.H., 2017. Skills training via smartphone app for university students with excessive alcohol consumption: a randomized controlled trial. *Int. J. Behav. Med.* 24 (5), 778–788.
- Gardner, B., Smith, L., Lorencatto, F., Hamer, M., Biddle, S.J., 2016. How to reduce sitting time? A review of behaviour change strategies used in sedentary behaviour reduction interventions among adults. *Health Psychol. Rev.* 10 (1), 89–112.
- Garnett, C.V., Crane, D., Brown, J., Kaner, E.F.S., Beyer, F.R., Muirhead, C.R., Hickman, M., Beard, E., Redmore, J., de Vocht, F., Michie, S., 2018. Behavior change techniques used in digital behavior change interventions to reduce excessive alcohol consumption: a meta-regression. *Ann. Behav. Med.* 52, 530–543.
- Geisner, I.M., Varvil-Weld, L., Mittmann, A.J., Mallett, K., Turrisi, R., 2015. Brief web-based intervention for college students with comorbid risky alcohol use and depressed mood: does it work and for whom? *Addict. Behav.* 42, 36–43.
- Gomez, K.U., Goodwin, L., Jackson, L., Jones, A., Chisholm, A., Rose, A.K., 2020. Are psychosocial interventions effective in reducing alcohol consumption during pregnancy and motherhood? A systematic review and meta-analysis. *Addict.* <https://doi.org/10.1111/add.15296>.
- Gonzalez, V.M., Dulin, P.L., 2015. Comparison of a smartphone app for alcohol use disorders with an Internet-based intervention plus bibliotherapy: a pilot study. *J. Consult Clin. Psychol.* 83 (2), 335–345.
- Guilleumont, J., Cogordan, C., Nalpas, B., Nguyen-Thanh, V., Richard, J.-B., Arwidson, P., 2017. Effectiveness of a web-based intervention to reduce alcohol consumption among French hazardous drinkers: a randomized controlled trial. *Health Educ. Res* 32 (4), 332–342.
- Hailey, V., Rojas-Garcia, A., Kassianos, A.P., 2022. A systematic review of behaviour change techniques used in interventions to increase physical activity among breast cancer survivors. *Breast Cancer* 29, 193–208. <https://doi.org/10.1007/s12282-021-01323-z>.
- Hall, S.K., Samari, G., Garbers, S., Casey, S.E., Diallo, D.D., Orcutt, M., Moresky, R.T., Martinez, M.E., McGovern, T., 2020. Centring sexual and reproductive health and justice in the global covid-19 response. *Lancet* 395, 1175–1177.
- Hallward, L., Patel, N., Duncan, L.R., 2020. Behaviour change techniques in physical activity interventions for men with prostate cancer: a systematic review. *J. Health Psychol.* 25 (1), 105–122. <https://doi.org/10.1177/1359105318756501>.
- Haroon, S., Wooldridge, D., Hoogewerf, J., Nirantharakumar, K., Williams, J., Martino, L., Bhal, N., 2018. Information standards for recording alcohol use in electronic health records: findings from a national consultation. *BMC Med. Inf. Decis. Mak.* 18. <https://doi.org/10.1186/s12911-018-0612-z>.
- Hester, R.K., Delaney, H.D., Campbell, W., 2011. ModerateDrinking.Com and moderation management: outcomes of a randomized clinical trial with non-dependent problem drinkers. *J. Consult Clin. Psychol.* 79 (2), 215.
- Hester, R.K., Lenberg, K.L., Campbell, W., Delaney, H.D., 2013. Overcoming addictions, a Web-based application, and SMART Recovery, an online and in-person mutual help group for problem drinkers, part 1: three-month outcomes of a randomized controlled trial. *J. Med. Internet Res.* 15 (7), e2565.
- Howlett, N., Trivedi, D., Troop, N.A., Chater, A.M., 2019. Are physical activity interventions for healthy inactive adults effective in promoting behavior change and maintenance, and which behavior change techniques are effective? A systematic review and meta-analysis. *Transl. Behav. Med.* 9 (1).

- Hong, Q.N., et al., 2019. Improving the content validity of the mixed methods appraisal tool: a modified e-Delphi study. *Journal of Clinical Epidemiology* 111, 49–59. <https://doi.org/10.1016/j.jclinepi.2019.03.008>.
- Howlett, N., Garcia-Iglesias, J., Breslin, G., Bartington, S., Jones, J., Brown, K., Wills, W., 2021. Remote delivery of alcohol and/or substance misuse interventions for adults: a systematic review protocol. *PLoS One* 16 (11), e0259525.
- Jonas, B., Tensil, M.-D., Tossman, P., Strüber, E., 2018. Effects of treatment length and chat-based counseling in a web-based intervention for cannabis users: randomized factorial trial. *J. Med. Internet Res.* 20 (5), e166.
- Justice, A.C., Smith, R.V., Tate, J.P., McGinnis, K., Xu, K., Becker, W.C., Lee, K.-Y., Lynch, K., Sun, N., Concato, J., Fiellin, D.A., Zhao, H., Geleertner, J., Kranzler, H.R., 2018. AUDIT-C and ICD codes as phenotypes for harmful alcohol use: association with ADH1B polymorphisms in two US populations. *Addict* 113 (12), 2214–2224. <https://doi.org/10.1111/add.14374>.
- Kaner, E.F.S., Beyer, F.R., Garnett, C., Crane, D., Brown, J., Muirhead, C., 2017. Personalised digital interventions for reducing hazardous and harmful alcohol consumption in community dwelling populations. *Cochrane Database Syst. Rev.* 9, CD011479. <https://doi.org/10.1002/14651858.CD011479.pub2>.
- Kazemi, D.M., Borsari, B., Levine, M.J., Li, S., Lamberson, K.A., Matta, L.A.A., 2017. Systematic review of the mhealth interventions to prevent alcohol and substance abuse. *J. Health Com. Res.* 22 (5), 413–432. <https://doi.org/10.1080/10810730.2017.1303556>.
- Kramer, J., Ripper, H., Lemmers, L., Conijn, B., van Straten, A., Smit, F., 2009. Television supported self-help for problem drinkers: a randomized pragmatic trial. *Addict. Behav.* 34 (5), 451–457.
- Kypri, K., Hallett, J., Howat, P., McManus, A., Maycock, B., Bowe, S., Horton, N.J., 2009. Randomized controlled trial of proactive web-based alcohol screening and brief intervention for university students. *Arch. Intern Med.* 169 (16), 1508–1514.
- Kypri, K., McCambridge, J., Vater, T., Bowe, S.J., Saunders, J.B., Cunningham, J.A., Horton, N.J., 2013. Web-based alcohol intervention for Māori university students: double-blind, multi-site randomized controlled trial. *Addiction* 108 (2), 331–338.
- Lee, C.M., Neighbors, C., Lewis, M.A., Kaysen, D., Mittmann, A., Geisner, I.M., Atkins, D. C., Zheng, C., Garberson, L.A., Kilmer, J.R., Larimer, M.E., 2014. Randomized controlled trial of a Spring Break intervention to reduce high-risk drinking. *J. Consult. Clin. Psychol.* 82 (2), 189–201.
- Martin, J., Chater, A., Lorencatto, F., 2013. Effective behaviour change techniques in the prevention and management of childhood obesity. *Int. J. Obes.* 37 (10), 1287–1294.
- Michie, S., Abraham, C., Whittington, C., McAteer, J., Gupta, S., 2009. Effective techniques in healthy eating and physical activity interventions: a meta-regression. *Health Psychol.* 28 (6), 690.
- Michie, S., Richardson, M., Johnston, M., Abraham, C., Francis, J., Hardeman, W., Eccles, M.P., Cane, J., Wood, C.E., 2013. The behavior change technique taxonomy (v1) of 93 hierarchically clustered techniques: building an international consensus for the reporting of behavior change interventions. *Ann. Behav. Med.* 46 (1), 81–95. NHS Digital, Statistics on drug misuse, England 2020. Available at: (<https://digital.nhs.uk/data-and-information/publications/statistical/statistics-on-drug-misuse/2020>).
- Nyman, S.R., Adamczewska, N., Howlett, N., 2018. Systematic review of behaviour change techniques to promote participation in physical activity among people with dementia. *Br. J. Health Psychol.* 23 (1), 148–170. <https://doi.org/10.1111/bjhp.12279>.
- O'Donnell, R., Richardson, B., Fuller-Tyszkiewicz, M., Staiger, P.K., 2019. Delivering personalized protective behavioral drinking strategies via a smartphone intervention: a pilot study. *Int. J. Behav. Med.* 26 (4), 401–414.
- Page, M.J., McKenzie, J.E., Bossuyt, P.M., Boutron, I., Hoffmann, T.C., Mulrow, C.D., Shamseer, L., Tetzlaff, J.M., Akl, E.A., Brennan, S.E., Chou, R., Glanville, J., Grimshaw, J.M., Hróbjartsson, A., Lahu, M.M., Li, T., Loder, E.W., Mayo-Wilson, E., McDonald, S., McQuinn, L.A., Stewart, L.A., Thomas, J., Tricco, A.C., Welch, V.A., Whiting, P., Moher, D., 2021. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *BMJ* 372, n71. <https://doi.org/10.1136/bmj.n71>.
- Paschall, M.J., Antin, T., Ringwalt, C.L., Saltz, R.F., 2011. Evaluation of an Internet-based alcohol misuse prevention course for college freshmen: findings of a randomized multi-campus trial. *Am. J. Prev. Med.* 41 (3), 300–308.
- Pedersen, E.R., Parast, L., Marshall, G.N., Schell, T.L., Neighbors, C., 2017. A randomized controlled trial of a web-based, personalized normative feedback alcohol intervention for young-adult veterans. *J. Consult. Clin. Psychol.* 85 (5), 459–470.
- Pew Research Center. Internet, science & tech: mobile fact sheet, 2017. Available at: (<https://www.pewresearch.org/internet/fact-sheet/mobile/>).
- Postel, M.G., de Haan, H.A., ter Huurne, E.D., Becker, E.S., de Jong, C.A.J., 2010. Effectiveness of a web-based intervention for problem drinkers and reasons for dropout: randomized controlled trial. *Journal of Medical Internet Research* 12 (4). <https://doi.org/10.2196/jmir.1642>.
- Reback, C.J., Fletcher, J.B., Swendeman, D.A., Metzner, M., 2019. Theory-based text messaging to reduce methamphetamine use and HIV sexual risk behaviors among men who have sex with men: automated unidirectional delivery outperforms bidirectional peer interactive delivery. *AIDS Behav.* 23 (1), 37–47.
- Riggs, N.R., Conner, B.T., Parnes, J.E., Prince, M.A., Shillington, A.M., George, M.W., 2018. Marijuana eCHECKUP TO GO: effects of a personalized feedback plus protective behavioral strategies intervention for heavy marijuana-using college students. *Drug Alcohol Depend.* 190, 13–19.
- Ripper, H., Kramer, J., Smit, F., Conijn, B., Schippers, G., Cuijpers, P., 2008. Web-based self-help for problem drinkers: a pragmatic randomized trial. *Addiction* 103 (2), 218–227.
- Ripper, H., Kramer, J., Conijn, B., Smit, F., Schippers, G., Cuijpers, P., 2009. Translating effective web-based self-help for problem drinking into the real world. *Alcohol Clin. Exp. Res.* 33 (8), 1401–1408.
- Rooke, S., Copeland, J., Norberg, M., Hine, D., McCambridge, J., 2013. Effectiveness of a self-guided web-based cannabis treatment program: randomized controlled trial. *J. Med. Internet Res.* 15 (2), e26.
- Rose, G.L., Badger, G.J., Skelly, J.M., MacLean, C.D., Ferraro, T.A., Helzer, J.E., 2017. A randomized controlled trial of brief intervention by interactive voice response. *Alcohol Alcohol* 52 (3), 335–343.
- Sanchez, Z.M., Sanudo, A., 2018. Web-based alcohol intervention for nightclub patrons: Opposite effects according to baseline alcohol use disorder classification. *Subst. Abuse* 39 (3), 361–370.
- Saunders, J.B., Aasland, O.G., Babor, T.F., Fuente, J.R., Grant, M., 1993. Development of the Alcohol Use Disorders Identification Test (AUDIT): WHO collaborative project on early detection of persons with harmful alcohol consumption-II. *Addict* 88 (6), 791–804. <https://doi.org/10.1111/j.1360-0443.1993.tb02093.x>.
- Schaub, M.P., Wenger, A., Berg, O., Beck, T., Stark, L., Buehler, E., Haug, S., 2015. A web-based self-help intervention with and without chat counseling to reduce cannabis use in problematic cannabis users: three-arm randomized controlled trial. *J. Med. Internet Res.* 17 (10), e4860.
- Schaub, M.P., Castro, R.P., Wenger, A., Baumgartner, C., Stark, L., Ebert, D.D., Quednow, B.B., Haug, S., 2019. Web-based self-help with and without chat counseling to reduce cocaine use in cocaine misusers: results of a three-arm randomized controlled trial. *Internet Inter.* 17.
- Schulz, D.N., Candel, M.J.J.M., Kremers, S.P.J., Reinwand, D.A., Jander, A., de Vries, H., 2013. Effects of a Web-based tailored intervention to reduce alcohol consumption in adults: randomized controlled trial. *J. Med. Internet Res.* 15 (9), e2568.
- Serafino P. Exploring the UK's digital divide. Office for National Statistics, 2019. Available at: (<https://www.ons.gov.uk/peoplepopulationandcommunity/householdcharacteristics/hmeinternetandsocialmediausage/articles/exploringtheukdigitaldivide/2019-03-04>).
- Sinadinovic, K., Wennberg, P., Johansson, M., Berman, A.H., 2014. Targeting individuals with problematic alcohol use via Web-based cognitive-behavioral self-help modules, personalized screening feedback or assessment only: a randomized controlled trial. *Eur. Addict. Res.* 20 (6), 305–318.
- Staniszewska, S., Brett, J., Simera, I., Seers, K., Mockford, C., Goodlad, S., Altman, D.G., Moher, D., Barber, R., Denegri, S., Entwistle, A., Littlejohns, P., Morris, C., Suleman, R., Thomas, V., Tysall, C., 2017. GRIPP2 reporting checklists: tools to improve reporting of patient and public involvement in research. *BMJ* 358.
- Sterne, J., et al., 2019. RoB 2: a revised tool for assessing risk of bias in randomised trials. *BMJ* 366 (14898). <https://doi.org/10.1136/bmj.14898>.
- Suffoletto, B., Callaway, C., Kristan, J., Kraemer, K., Clark, D.B., 2012. Text-message based drinking assessments and brief interventions for young adults discharged from the emergency department. *Alcohol Clin. Exp. Res.* 36 (3), 552–560.
- Suffoletto, B., Kristan, J., Callaway, C., Kim, K.H., Chung, T., Monti, P.M., Clark, D.B., 2014. A text message alcohol intervention for young adult emergency department patients: a randomized clinical trial. *Ann. Emerg. Med.* 64 (6), 664–672 e4.
- Suffoletto, B., Kirisci, L., Clark, D.B., Chung, T., 2019. Which behavior change techniques help young adults reduce binge drinking? A pilot randomized clinical trial of 5 text message interventions. *Addict. Behav.* 92, 161–167.
- Sundström, C., Gajecki, M., Johansson, M., Blankers, M., Sinadinovic, K., Stenlund-Gens, E., Berman, A.H., 2016. High-intensity therapist-guided internet based cognitive behavior therapy for alcohol use disorder: a pilot study. *BMC Psychiatry* 17 (1).
- Tensil, M.-D., Jonas, B., Strüber, E., 2013. Two fully automated web-based interventions for risky alcohol use: randomized controlled trial. *J. Med. Internet Res.* 15 (6), e110.
- Tiburcio, M., Lara, M.A., Martínez, N., Fernández, M., Aguilar, A., 2018. Web-based intervention to reduce substance abuse and depression: a three-arm randomized trial in Mexico. *Subst. Use Misuse* 53 (13), 2220–2231.
- Timothy, R.K. Coronavirus is not the great equalizer—race matters. The Conversation 2020; April 6. Available at: (<https://theconversation.com/coronavirus-is-not-the-great-equalizer-race-matters-133867>).
- Tossmann, H.-P., Jonas, B., Tensil, M.-D., Lang, P., Strüber, E., 2011. A controlled trial of an internet-based intervention program for cannabis users. *Cyber Behav. Soc. Netw.* 14 (11), 673–679.
- United Nations Office of Drug and Crime. World Drug Report 2021. Available at: (<http://www.unodc.org/unodc/en/data-and-analysis/wdr2021.html>).
- Volkow, N.D., Balcer, R.D., Compton, W.M., Weiss, S.R.B., 2014. Adverse health effects of marijuana use. *N. Engl. J. Med.* 370 (23), 2219–2227. <https://doi.org/10.1056/NEJMra1402309>.
- Voogt, C., Kuntsche, E., Kleinjan, M., Poelen, E., Engels, R., 2014. Using ecological momentary assessment to test the effectiveness of a web-based brief alcohol intervention over time among heavy-drinking students: randomized controlled trial. *J. Med. Internet Res.* 16 (1), e2817.
- Voogt, C.V., Poelen, E.A.P., Kleinjan, M., Lemmers, L.A.C.J., Engels, R.C.M.E., 2013. The effectiveness of the “what do you drink” web-based brief alcohol intervention in reducing heavy drinking among students: a two-arm parallel group randomized controlled trial. *Alcohol Alcohol* 48 (3), 312–321.
- Wagener, T.L., Leffingwell, T.R., Mignogna, J., Mignogna, M.R., Weaver, C.C., Cooney, N.J., Claborn, K.R., 2012. Randomized trial comparing computer-delivered and face-to-face personalized feedback interventions for high-risk drinking among college students. *J. Subst. Abuse Treat.* 43 (2), 260–267.
- Wallace, P., Struzzo, P., Della Vedova, R., Scafuri, F., Tersar, C., Lygidakis, C., McGregor, R., Scafato, E., Hunter, R., Freemantle, N., 2017. Randomised controlled non inferiority trial of primary care-based facilitated access to an alcohol reduction website. *BMJ Open* 7 (11), e014576.
- White, A., Kavanaugh, D., Stallman, H., Klein, B., Kay-Lambkin, F., Proudfoot, J., Drennan, J., Connor, J., Baker, A., Hines, E., Young, R., 2010. Online alcohol

- interventions: a systematic review. *J. Med. Internet Res.* 12 (5), e62 <https://doi.org/10.2196/jmir.1479>.
- WHO, Fact sheets: Alcohol. World Health Organisation, 2018a. Available at: (<https://www.who.int/news-room/fact-sheets/detail/alcohol>).
- WHO, Global status report on alcohol and health, 2018b. Available from: (<https://www.who.int/publications/i/item/9789241565639>).
- WHO, World Drug Report 2020: Drug Use and Health Consequences (2). World Health Organization, 2020. Vienna: United Nations. Available at ([https://wdr.unodc.org/uploads/wdr2020/documents/WDR20\\_Booklet\\_2.pdf](https://wdr.unodc.org/uploads/wdr2020/documents/WDR20_Booklet_2.pdf)).
- Wilks, C.R., Lungu, A., Ang, S.Y., Matsumiya, B., Yin, Q., Linehan, M.M., 2018. A randomized controlled trial of an Internet delivered dialectical behavior therapy skills training for suicidal and heavy episodic drinkers. *J. Affect Disord.* 232, 219–228.
- Wright, C., Dietze, P.M., Agius, P.A., Kuntsche, E., Livingston, M., Black, O.C., Room, R., Hellard, M., Lim, M.S.C., 2018. Mobile phone-based ecological momentary intervention to reduce young adults' alcohol use in the event: a three-armed randomized controlled trial. *JMIR mHealth uHealth* 6 (7), e9324.