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TAILORED DIGITAL INTERVENTIONS TO REDUCE ALCOHOL CONSUMPTION: A SECONDARY ANALYSIS OF A SYSTEMATIC REVIEW

CLÁUDIA ALEXANDRA SANTIAGO LOPES

Orientador de Dissertação:

PROFESSORA DOUTORA MARTA MARQUES

Professor de Seminário de Dissertação:

PROFESSORA DOUTORA MARTA MARQUES

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RESUMO

Introdução: O consumo nocivo de álcool é um dos principais fatores de risco para problemas de saúde em todo o mundo. Existem algumas evidências de que as intervenções digitais de mudança de comportamento em saúde (IDMCS) podem ajudar as pessoas a reduzir o consumo de álcool. A possibilidade de personalização do conteúdo ou estrutura destas intervenções permite um maior ajustamento ao utilizador. Porém, não existe ainda uma compreensão profunda das características dessa personalização. *Objetivos:* identificar os componentes chave das IDMCS para redução do consumo de álcool em termos de: (i) características da personalização, (ii) modo de implementação, (iii) dose, (iv) uso da teoria, (v) efeito da intervenção. *Método:* Foi realizada uma análise secundária de uma revisão sistemática (Beyer et al., 2022) focada em estudos randomizados de intervenções digitais personalizadas. Com base nas classificações estandardizadas disponíveis, um investigador procedeu à extração de todos os artigos e um segundo investigador extraiu de forma independente informação de 20% das publicações. *Resultados:* Foram incluídos oitenta e nove estudos que incluíam 116 intervenções digitais. Apesar de todos os estudos reportarem mecanismos e táticas de personalização, nenhum fez referência a sistemas de classificação existentes. Praticamente todas as intervenções reportaram as características individuais com base nas quais a personalização foi efetuada, bem como o modo de implementação. A relação entre a teoria e a personalização esteve presente em menos de metade das intervenções (45%) e uma descrição completa da dose foi feita em 29% das intervenções. *Discussão:* A compilação da informação sobre as componentes das intervenções constituiu um desafio devido à falta de clareza e descrições detalhadas, principalmente no que diz respeito à relação entre a personalização e os outros elementos da intervenção. Este conhecimento é essencial para perceber a 'caixa negra' da personalização, que pode contribuir para a melhoria das IDMCS.

Palavras-chave: comportamentos de saúde, personalização, redução do consumo de álcool, tecnologia digital, revisão

ABSTRACT

Background: The harmful use of alcohol is one of the major risk factors for poor health globally. There is some evidence that digital health behaviour change interventions (DHBCIs) can help people reduce their alcohol intake. These interventions allow for higher precision by tailoring the content or structuring it to the user. However, a deeper understanding of tailoring characteristics is still missing. *Objectives:* To identify the core components of DHBCIs for alcohol reduction in terms of (i) tailoring characteristics, (ii) modes of delivery, (iii) dose, (iv) use of theory, (v) intervention effect. *Methods:* A secondary analysis of a systematic review (Beyer et al., 2022) was performed covering randomized controlled trials reporting digitally delivered tailored interventions. Using available standardized classification systems, one researcher retrieved relevant data from all reports and a second researcher independently extracted information for 20% of the publications. *Results:* Eighty-nine studies were included, which reported 116 digital interventions. Despite all studies having reported tailoring mechanisms and tactics, none referred to the existing categorization. Reporting of individual factors in which tailoring was based on and of the mode of delivery was done for almost all interventions. Links between theory and tailoring were presented in less than half of the interventions (45%) and complete descriptions of dose were done in 29% of the interventions. *Discussion:* Due to a lack of clarity and detailed descriptions of the interventions, the compilation of information about its components was challenging, especially the reporting of the connections between tailoring and the other essential intervention elements. This knowledge is essential to understand the 'black box' of tailoring which can enhance DHBCIs.

Keywords: health behaviour, tailoring, alcohol consumption reduction, digital technology, review

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Introduction

Alcohol abuse is linked to more than 200 diseases (e.g., liver diseases, cancers, cardiovascular diseases), and the burden of disease (e.g., premature death, disability) is greater than that brought on by many other risk factors and illnesses at the top of the global health priority list (World Health Organization [WHO], 2019). Digital health behaviour change interventions (DHBCIs, i.e., interventions delivered via a digital or mobile platform as a direct interface with participants that aim to influence health behaviours) have been found to be more cost-effective and potentially more widely applicable than face-to-face brief interventions (Cunningham & van Mierlo, 2009; Gulliver et al., 2010; Lintvedt et al., 2013). In the context of alcohol consumption, there is some evidence that DHBCIs can help people reduce their alcohol intake (Black et al., 2016; Kaner et al., 2017; Beyer et al., 2022).

DHBCIs allow for interventions with higher precision by using contextual, behavioural and individual characteristics to tailor the content or structure to the user. Enhancing DHBCIs through tailoring (i.e. 'any combination of strategies and information intended to reach one specific person, based on characteristics that are unique to that person, related to the outcome of interest and derived from an individual assessment' (Kreuter et al., 1999, p. 277)) is supported by recent systematic reviews across a range of illnesses and patient populations (Lustria et al., 2009, 2013; Morrison, 2015), with more research focused on certain modifiable behaviours more than others such as physical activity (Encantado et al., 2022; Gal et al., 2018; Lustria et al., 2013). However, prior research on tailored health interventions has mostly concentrated on determining whether tailoring is effective. A deeper analysis of the tailoring strategies and tactics employed, as well as its relations with other interventions' characteristics, would therefore be helpful to inform the development of future digital health interventions.

Alcohol consumption and its impact

The harmful use of alcohol is one of the main risk factors for poor health worldwide, ranking seventh among all risk factors for deaths and disability. In 2016, it caused around 3 million deaths, being responsible for 5.1% of the global burden of disease, as measured in disability-adjusted life years. The percentage of all deaths and disability-adjusted life-years (DALYs) caused by alcohol use were highest in the European Region, where alcohol intake was responsible for 10.1% of all deaths and 10.8% of all DALYs (Griswold et al., 2018; WHO, 2019). Besides, harmful use of alcohol also results in considerable social and financial

losses, decreased productivity at work and unemployment, as well as expenses related to pain and suffering (including to those close to the drinker) (WHO, 2019; 2021).

The most crucial elements of drinking are a hazardous volume of consumption (more than two drinks - 24 grams of ethanol, on average, per day), and if and to what extent there is heavy episodic drinking (HED; drinking about five or more drinks – approximately 60 grams of ethanol) (WHO, 2019). The number of standard drinks per week that caused the least amount of harm to all health outcomes was zero (Griswold et al., 2018). However, there has been no reduction in the world's overall per capita alcohol intake. An average daily consumption of 32.8 grams (40 grams among men) carries serious health concerns, making it a top priority for worldwide action lowering alcohol consumption among drinkers.

Policymakers are urged to use measures that have proven to be efficient and affordable to lessen the burden of unhealthy alcohol usage. The establishment of screening and brief psychosocial intervention programs for hazardous and harmful drinking in health services is one of the proposed initiatives by the World Health Organization (2017; 2019; 2021).

Behaviour change interventions

Addressing unhealthy behaviours related to alcohol consumption can lower the chance of developing chronic diseases, as well as enhance social, emotional and mental health. Additionally, it can assist people in self-managing or self-monitoring their alcohol use or mental health issues with the goal of lowering their alcohol intake (National Institute for Health and Care Excellence [NICE], 2020). In order to develop and implement effective DHBCIs to reduce alcohol consumption there is a need to identify what components should be included in these interventions according to the available evidence and theoretical underpinnings. Behaviour change interventions (BCIs) are 'policies, activities, services or products designed to induce or support people to act differently from how they would have acted otherwise' (Michie et al., 2017, p.2). These attempt to change either the characteristics of the target population (e.g., their knowledge, beliefs, skills, habits or feelings), their social or physical environment, or both (Michie et al., 2017).

The development of BCIs can be a cost-effective solution to reduce alcohol consumption, as interventions that can produce small changes in significant health behaviours can result in substantial public health improvements (NICE, 2007; 2014).

The contexts and evaluation methods of BCIs are heterogenous, making it challenging to synthesize the available data and offer suggestions for actual policy and practice. Improving the effects of BCIs requires the specification of all features consistently and in great detail (e.g., intervention content, mode of delivery, mechanism of action, context) (Marques et al., 2021; Michie el al., 2017). Therefore, the creation of formal frameworks for accurately and succinctly describing behavioural theories and interventions are essential (Michie el al., 2021). Having a set of standardised and operationalised behaviour change techniques (BCTs) facilitates the design of interventions, as well as their reporting, replication, and implementation (Michie et al., 2012, Marques et al., 2021).

The widely used Behaviour Change Techniques Taxonomy (BCTTv1), developed by Michie et al. (2013), is one of the previously established classification systems for defining BCTs. This taxonomy established the groundwork for the systematic and reliable characterisation of BCIs allowing the identification of 'active ingredients' within intervention components and the conditions under which they are effective.

Research examining the development, assessment and use of BCIs to address alcohol consumption, as well as existing evidence syntheses, show a startling variation in effectiveness across studies (Flodgren et al., 2017; NICE, 2020). A detailed analysis of the characteristics of these interventions could contribute for their improvement.

Digital health behaviour change interventions

BCIs aiming to influence health behaviours can be delivered via digital or mobile platforms as a direct interface with participants. These DHBCIs include the use of hardware, electronic devices (e.g., smartphones, smartwatches, wearable devices), software (e.g., apps, computer programs) and websites. Digital or mobile health interventions are often automated, interactive, and personalised. Even though these interventions may entail some direct or continued contact with a practitioner or healthcare professional, the primary action, intervention process or behaviour change strategies should be delivered by the digital or mobile health technology itself (NICE, 2020).

Many people who have never sought therapy before are being reached through DHBCIs, which is becoming more widely accepted and a substantial component of mental health care provided globally (Titov et al., 2018). Despite inconsistent evidence regarding digital and mobile health interventions' effectiveness for behaviour change, there is now relevant evidence that some digital interventions can have significant effects (Hagger et al.,

2020; NICE, 2020; Prestwich, et al., 2018). Systematic reviews of DHBCIs have revealed that they can be more successful than controls at reducing hazardous and harmful alcohol use (Black et al., 2016; Kaner et al., 2017; Beyer et al., 2022).

Black et al. (2016) meta-analysis and meta-regression included randomised studies that compared self-directed computer-delivered interventions (CDIs) to assessment only control groups (n = 93 CDIs). The average effect of CDIs on alcohol consumption was small but significant. The HED frequency had the least effect (d+ = 0.07), whereas the total consumption had the biggest effect (d+ = 0.15). In the short term, the effects produced by CDIs were small-to-medium on all outcomes (d+ = 0.16–0.31), except drinking frequency (d+ = 0.06). In the medium-to-long term, CDIs had small significant effects on all outcomes (d+ = 0.07–0.12). In Kaner et al. (2017) meta-analysis, covering 41 trials, the authors concluded that there is fair-quality evidence that suggests digital interventions may reduce the quantity of alcohol consumed per week. Participants who received a digital intervention drank at the end of the follow-up period approximately 23 g less alcohol per week (95% CI 15 to 30) compared to control group.

Building on previous investigations, the most recent systematic review and meta-analysis was conducted by Beyer et al. (2022), and it compared the interventions' efficacy of those administered by practitioners to those delivered online (n = 201 trials, 199 papers). Practitioner-delivered interventions for reducing hazardous and harmful alcohol consumption were found to be more effective than digital interventions. This mean difference in alcohol consumption in grams per week was verified at 1 and 6 months (1 month: −23 g/wk [95% CI, −43 to −2]; 6 months: −14 g/wk [95% CI, −25 to −3]), but not at 12 months (−6 g/wk [95% CI, −24 to 12]).

According to NICE (2020), there is limited evidence that DHBCIs can help consumers reduce their alcohol consumption. However, the committee acknowledged that some interventions might be effective and work for some individuals, recommending therefore the use of mobile and digital health interventions to reduce alcohol intake in addition to other individual behaviour modification services. When designing these interventions, NICE (2020) recommends employing approaches for behaviour change that are supported by evidence and that assist individuals in initiating and sustaining change. It is also suggested that the interventions enable the user to tailor the goals to their needs.

Tailoring as a strategy to enhance ehealth/digital interventions

There are several factors that influence the success of DHBCIs. These include the intervention's content, the underlying theory, as well as how it is tailored to individuals (Prestwich et al., 2018). Evidence regarding DHBCIs to reduce alcohol consumption suggests that 'one size does not fit all' (NICE, 2020). In Kreuter et al. original definition, tailoring was defined as 'any combination of strategies and information intended to reach one specific person, based on characteristics that are unique to that person, related to the outcome of interest and derived from an individual assessment' (1999, p. 277). Compared to generic, non-personalised health messages, tailored ones command more attention and are more likely to be read, elaborated on, recalled, and comprehended (Lustria et al., 2009; Ryan et al., 2019).

The sophistication of tailoring has been greatly enhanced by digital technology. Powerful expert systems now make it feasible to automate the gathering of personal data, which can subsequently be utilized to create personalised health plans and offer individualised feedback. Web-based tailored intervention programs hold great potential for changing patient habits and enhancing health outcomes for a wide range of illnesses and patient populations (Lustria et al., 2009, 2013; Morrison, 2015).

Tailoring is a multi-step and multidimensional process. The first step consists of the assessment of an individual's characteristics, needs and theoretically significant elements connected to the targeted behaviour (e.g., motivations, attitudes, beliefs, risk behaviours). Personalised messages are developed based on the assessment and then conveyed through several appropriate strategies and channels. The multi-faced communication aims to increase perceived personal relevance of health messages contributing, subsequently, to the creation of situations that are conducive to persuasion and behaviour change (Lustria et al., 2009, 2016; Noar et al., 2011).

Persuasive information can be tailored to individual characteristics using computer technology through personalisation, feedback, and content matching. Personalisation refers to the incorporation of one or more recognizable individual features in the content information to boost attention, interest and motivation to process information. Identification, raising expectation and contextualization are the most common personalisation tactics. Identification is expected to enhance exposure likelihood or attention devoted to information. Raising the bar for customization entails making overt assertions of it (e.g., 'the following health information has been uniquely designed for you'), while personalisation consists of framing

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one's communication in a context that is significant to the audience (Dijkstra, 2008; Hawkins et al., 2008).

The second tailoring strategy, feedback, involves letting the person know something about him or herself that is relevant to significant personal objectives. Feedback can be descriptive, comparative, or evaluative. Descriptive feedback consists of reporting back to individuals a summary of their beliefs, attitudes or behaviours from observational data or personal assessments. In comparative feedback, a person beliefs, attitudes or behaviours is compared to those of others. In evaluative feedback a level of interpretation, inference and/or judgement is added. Finally, content matching, often thought as the essence of tailoring, addresses key theoretical determinants of the behaviour of interest (e.g., knowledge, normative beliefs, outcome expectations, skills and/or efficacy) (Dijkstra, 2008; Hawkins et al., 2008).

Providing feedback on the behaviour is typically the minimal amount of tailoring that has been conducted in the literature (Noar et al., 2007). Even though tailoring ingredients are presented as separate strategies, they are frequently utilised in conjunction with one another and with different methods from the same category. The choice of certain strategies and tactics should be deliberate, informed by theory and/or empirical research, and take into consideration the benefits and disadvantages of each strategy (Hawkins et al., 2008).

Several systematic reviews and meta-analyses have found that tailoring can be an effective strategy for changing health behaviours across a wide variety of health outcomes, pointing to small and moderate effects (Krebs et al., 2010; Lustria et al., 2009, 2013; Noar et al., 2007; Ryan et al., 2019). Noar et al. (2007) meta-analysed 57 studies investigating whether tailored printed messages have influenced changes in health behaviours. The mean effect size of tailoring on health behaviour change was found to be $r = .074$ (95% CI = .066, .082), slightly less than the conventional standard messages which had a small effect size ($r = .10$). There was significant heterogeneity among effect sizes.

Lustria et al. (2009) conducted a systematic review to investigate how computer-tailored, online behavioural interventions have been operationalized in various contexts, and what criteria and mechanisms are employed to customize health messages. The authors concluded that the features and formats used in tailored self-directed health interventions delivered via the web have been extremely diverse. The interventions in the 30 studies ranged in sophistication from quick risk/health assessments, tailored web content, to fully developed

personalised health programs. Health behaviours and stages of change were the most common variables for tailoring content. A combination of feedback, personalisation and adaptation was used to tailor messages.

Lustria et al. (2013) investigated the efficacy of tailored web-based interventions on health behaviour outcomes and explored moderators of intervention efficacy. The meta-analysis included forty experimental and quasi-experimental studies targeting physical activity, medication adherence, smoking/tobacco use, drinking, nutrition, stress management and faecal soiling. Moderators tested included participants (e.g., gender, age, population type, behaviour studied) intervention/tailoring (frequency of tailoring assessment and user control) and methodological characteristics (study design, type of comparison condition, study retention and length of follow-up). There was a lot of variation in the methods used for tailoring among the articles they featured, including variations in intervention features, formats, and levels of interactivity. The results showed that web-based tailored interventions significantly improved health outcomes compared to control circumstances both at post-testing, $d = .139$ (95% CI = .111, .166, $p < .001$, $k = 40$) and follow-up, $d = .158$ (95% CI = .124, .192, $p < .001$, $k = 21$).

Although research into the underlying mechanics of tailoring has started, we still do not fully understand how it operates or why it is more effective than non-tailored alternatives (Lustria et al., 2016). Prior research on tailored health interventions has mostly concentrated on determining whether tailoring is effective, as opposed to studying how it works or which approaches are most beneficial and under which situations. This research has struggled to distinguish between the various methodologies, modality distinctions, intervention aspects, and component types (Dijkstra, 2008; Hawkins et al., 2008; Lustria et al., 2013).

Harrington and Noar (2012) provided several recommendations for reporting studies of tailored interventions, including the description of i) the theoretical variables used on intervention message design, ii) how the theory informed intervention message design, iii) what type of tailored messages participants receive, iv) the tailoring system algorithms, v) the tailoring intervention channel, format, dosage, and context, and vi) when the intervention is delivered and assessment schedule.

Several questions remain without answer, namely, which factors affect the success of a behavioural intervention, what aspects of the intervention are specifically tailored (e.g., content, mode of delivery, intensity/duration) and on what basis (e.g., participant

characteristics, environment, etc.), and how is the underlying theory used to tailor the interventions (Prestwich et al., 2018). Therefore, there is a need to explore the tailored components of DHBCIs to reduce alcohol intake, in order to gain a greater understanding of how these interventions work, who might benefit most from them, and in which contexts.

Aims of the study

The aim of the present study is to review the evidence of tailored digital interventions for alcohol consumption reduction. Specifically, it aims to answer the following research questions:

1) What are the tailoring strategies and tactics applied in DHBCIs to reduce harmful and hazardous alcohol consumption?

2) What are the other components (e.g., mode of delivery, use of theory to inform intervention content, messaging architecture such as dose and schedule) of tailored DHBCIs to reduced hazardous or harmful drinking and how are they linked?

Methods

This is a secondary analysis of a systematic review on DHBCIs targeting hazardous or harmful drinking which aimed to compare the effectiveness of practitioner and digitally delivered interventions (Beyer et al., 2022). The current analysis focuses exclusively on digital interventions. These were characterised as being primarily provided by a device, a programmable computer or mobile device (e.g., laptop, phone, or tablet), being responsive to user input to create personalised content, and with the goal of altering the participants' alcohol-related behaviours.

Search strategy

Initially, there was a preliminary search conducted on EBSCO with the aim of identifying existing reviews and relevant studies. This search combined terms for hazardous or harmful alcohol consumption (e.g., alcohol, drinking, alcohol use) with terms for digital interventions (e.g., online, internet, computer, web-based, mobile, ehealth, mhealth), tailoring (e.g., tailor*, custom* or person*) and behaviour change.

The identification of Beyer et al. (2022) systematic review, which contained studies published up to 2020, made it clear that there was no need to duplicate the stages of study search and selection. Instead, a secondary analysis of the trials included in the review would be performed, to do an in-depth analysis of tailoring.

The search strategy of the above-mentioned review (Beyer et al., 2022) involved several steps. Trials of digitally delivered interventions were identified from a Cochrane review (Kaner et al., 2017) with an updated search, backed up with references checked from a recent systematic review of digital interventions (Field et al., 2019). Updated searches were conducted from January 2016 to April 2020 using the following databases: MEDLINE, Cochrane Library, EMBASE, PsycINFO, CINAHL, ERIC, Web of Knowledge (SSCI, SCI-EXPANDED, ESCI, CPCI-S), ProQuest. Databases were searched for terms such as: alcohol drinking; harmful or hazard; internet or computers or smartphone; e-SBI or eheath or mhealth, and randomized controlled trial.

In total, 92 trials provided one or more digitally delivered interventions. Of these, there were three trials that could not be retrieved (Fernandez Saint Martin et al., 1997; Sugarman, 2009 and Young, 2019).

Eligibility criteria

The inclusion criteria of the digitally delivered interventions in Beyer et al. (2022) were: randomised controlled trials comparing a digitally tailored intervention to a control group (assessment only, an attention control not involving information about alcohol consumption, and/or a control condition providing brief verbal or written advice about hazardous consumption); non-treatment seeking individuals with hazardous or harmful consumption; all trials targeted and reported consumption; report follow up after, at least, one month; did not apply a time limit to interventions but included all that were described as brief; all interventions had to provide personalised feedback; there was no restriction based on the style of intervention, language, date of publication or location.

Exclusion criteria included: trials in which participant were mandated to receive the intervention, were seeking treatment for alcohol problems, or were known to be physically dependent on alcohol; interventions that included other behaviours (e.g., risky social behaviour) and blended interventions (which comprised a computer deliver intervention with integrated human support).

Data charting process

Data of interest was extracted from all reports by one researcher (MSc student). For 20% of the included studies, data was also independently extracted by another researcher (CS). This was done through an iterative process. Disagreements were resolved through discussion and, when needed, with the help of a third investigator (MM). Whenever the

articles referred to other studies, protocols or trial registrations for further information on the intervention' characteristics, these were retrieved and information was extracted from these additional articles.

Beyer et al. (2022) extracted the following study characteristics: authors, year of publication, length of intervention (follow-up), recruitment setting, intervention name, mean age of participants, country where the study took place, type of control (assessment only, attention control or minimal alcohol information) and type of intervention: digital, integrated (input to a digital intervention from a person), combined (person and a device both being used to deliver the same intervention (e.g., a person delivering an intervention a supported by feedback on a device) or both (separate arms for practitioner and digitally delivered interventions).

For this analysis, in addition to the information aforementioned, the following study characteristics were also extracted (see Appendix F):

i.   Study and sample details: type of study, gender and sample.

ii.   Intervention components:

   a)   Individual factors assessed as part of the tailoring process.

   b)   Tailoring mechanisms and tactics as conceptualised by Dijkstra (2008) and Hawkins et al. (2008).

   c)   Static or dynamic tailoring as defined by Krebs et al. (2010). Dynamic tailoring consists of assessing intervention variables prior to each feedback (i.e., iterative assessments and feedback), while in static tailoring there is only one baseline assessment in which feedbacks are based.

   d)   Dose: Information about dose was extracted based on the elements of intensity described by Dombrowski et al. (2016), namely, duration (e.g., 1 hr, 4 weeks), number of contacts (e.g., 1 contact, 122 contacts), length of contacts (e.g., 5 min, 1 hr) and frequency (e.g., daily, weekly, monthly).

   e)   Mode of delivery (MoD): Information about MoDs were extracted using the MoD Ontology develop by Marques et al. (2021), for the informational upper-level class, including sub-level 1, 2 and 3.

f) Use of theory: We coded if interventions were theory-based as per authors reports, which theory(ies) were used, and if a rational was provided for the use of theory.

iii. Intervention effects considering the following categories: Superior Significant (intervention group superior to the control group with statistical significance); Superior Non-Significant (intervention group in relation to control with statistically non-significant superiority); No difference (statistically no difference in the outcome of intervention and control groups); Inferior (control group statistical superiority in relation to the intervention). Intervention effects were categorized based on primary outcomes related with alcohol consumption. If there was at least one indicator (e.g., quantity, frequency, binge drinking episodes) with statistical significant difference it was categorized as superior significant independently of the follow up period. Whenever the results were analysed for the total sample, the effect is relative to the whole group.

Information extracted was summarised and is presented in tables: Study characteristics (Table B1), tailoring mechanisms and tactics (Table B2), intervention characteristics (Table 2) and theory use (Table B3).

A narrative synthesis (descriptive) of the findings was conducted regarding the tailoring strategies and tactics of the DHBCIs, as well as the identification and summarisation of intervention components (e.g., individual factors assessed as part of tailoring process, theories, mode of delivery, dosage). When suitable, a quantitative summary is presented through descriptive statistics.

Results

Studies' characteristics

Studies' characteristics are detailed in Table B1 and summarised here. Trials took place in the United States ($n = 45$, 52%), Canada ($n = 3$, 3%), both the United States and Canada ($n = 2$, 2%), United Kingdom ($n = 4$; 4%), Europe ($n = 25$, 27%), Australasia ($n = 8$, 9%) and Asia ($n = 2$, 2%). The years of publication of the 89 articles ranged from 1997 to 2020, and included 92 trials. All studies were randomised controlled trials (RCTs) of various types. Total sample corresponds to 65781 participants with the lowest sample being 36 individuals (Araki et al., 2006) and the highest 7934 (Wallace et al., 2011), (median = 390.5). Percentage of females ranged from 0% (5 studies) to 100% (3 studies), with an average of

49% participants in the studies being female. In 16% of the studies, participant ages were not reported. In the trials that reported it the average age was 27.9.

A larger percentage of the recruitment setting was in the university (46%), followed by the community (14%), online (9%), primary care (8%), emergency care (6%), email (6%), workplace (5%), and 9% in other settings (e.g., school, army, HIV Clinic, etc.). Interventions were grouped into four categories based on their type: 'Digital' interventions (83%); 'Both', which had separate arms for practitioner- and digitally delivered interventions (10%); 'Combined', that blended the delivery of an intervention by a person and a device (6%), and 'Integrated', which required a person to input data into the digital intervention (2%). Duration of the studies ranged from 1 month (14%) to 24 months (1%) (median = 5).

The 89 studies analysed included 118 different digitally delivered intervention groups. 90% of the studies named the interventions, with 51 different interventions being mentioned. The most referred was PNF (15 studies), followed by eCHUG (7) and eSBI (5). Regarding the type of control, 56% of the trials consisted of assessment only (participant received a baseline assessment in which they reported their alcohol consumption, amongst other characteristics), 28% received minimal alcohol information (e.g., brochure or website with alcohol facts and effects), 11% was an attention control group provided with materials or tasks not related to alcohol consumption (e.g., information about health guidelines not related with alcohol, facts about students at the university).

Tailoring mechanisms and tactics

Even though all studies reported using tailoring mechanisms and tactics (see Table B2), none referred specifically to the categorisation proposed by Hawkins et al. (2008). As having personalised feedback was one of the eligibility criteria of Beyers et al. (2022) original study, it was expected that at least one feedback tactic would be employed. Results are synthesised on Table 1. The most used tactic was *normative or comparative feedback* ($n = 90$ interventions, 76%), followed by *descriptive feedback* ($n = 77$, 65%), and *evaluative or motivational feedback* ($n = 68$, 58%). Regarding personalisation, *contextualisation* was the most used tactic, but it was only present in 10 interventions (9%). Six trials (5%) described using the *identification* tactic, but none described intervention content as *raising expectations*. Regarding the third tailoring mechanism, *adaptation or content matching* was employed in 36 interventions (31%).

The number of tactics used in each intervention varied between one and five. Most of the interventions utilized two (36%) or three tactics (33%), 18% only reported one tactic and 12% used four tactics. The two studies that used five tailoring tactics were Hester et al. (2005) and McPherson (2012). On average, the number of tactics identified per intervention was 2.4.

Table 1

Tailoring mechanisms and tactics synthesis

Mechanisms and tactics	Frequency, n (%)
Personalisation	
Identification	7 (6)
Raising expectations	0 (0)
Contextualization	10 (9)
Feedback	
Descriptive	77 (65)
Normative and comparative	90 (76)
Evaluative and motivational	68 (58)
Adaptation/content matching	36 (31)

Individual factors in which tailoring was based on

One intervention was unclear about the individuals' factors tailoring was based on (Araki et al, 2006). In five interventions tailoring was based on one type of factor: alcohol consumption (Boβ et al., 2013; Deluca et al., 2020; Hansen et al., 2012; Khadjesari et al., 2014; Wallace et al., 2017). Wagener et al. (2012) had the highest number of personal characteristics, nine in total. Reported alcohol consumption was used to tailor the great majority of the interventions (90%). Many interventions that used normative feedback utilised gender (53%) and/or age (20%), and at a lesser extent race/ethnicity (6%). Weight was used to calculate eBAC levels in 28% of the trials. Other individual factors commonly used were: normative perceptions (36%), alcohol consequences/problems (19%), readiness to change (16%) and drinking goals (14%) (see Table 2).

Mode of delivery, dosage and static versus dynamic tailoring

All studies except one specified their MoD (Neighbors et al., 2010). Among the interventions only one involved human interaction (Hasin et al., 2013). In 41% of the

interventions the delivery involved a computer, 35% used a website, and 6% were delivered through a mobile device. In 27% of the interventions, printed MoD was offered by default or optionally. Other MoDs included: messaging (6%), email (5%), video call and audio call (2% each).

The reporting of dosage was somehow inconsistent with very few studies mentioning the duration, number of contacts and length of contacts. Frequency was absent in most cases. Number of contacts ranged from a single session (63% of the interventions) to 62 sessions in the two Brendryen et al. studies (2013, 2017). Most interventions with a single session (70%) had no mention of duration. In 5% of the interventions there was no fixed dosage, it was as much as participants decided.

In total, 60% of the interventions were static, i.e., there was only one baseline assessment from which feedback was based on. In 40% of the interventions, the tailoring was dynamic with multiple assessments or interactive interventions.

Methodological quality analysis

Risk of bias was assessed by Beyer et al. (2022) (see Appendix C). Trials were at high risk of bias in 49% of cases, unclear in 35% of cases, and low risk of bias in 15% of cases. According to these authors the overall assessment of risk of bias for each study adopted the highest level of each of the domains, except blinding.

Table 2

Intervention characteristics

#	Authors, year	Tailoring based on	Dosage Intensity/ duration	Static or Dynamic	Mode of Delivery	# Tailoring tactics	Use of theory	Intervention effect	Overall risk of bias assessment
1	Acosta et al., 2017	Problematic substance use Trauma symptoms	12 weeks 24 contacts 20m /contact	Dynamic	Website	1	CBT	↑↑ % drinking days and & heavy drinking days	High
2	Araki et al., 2006	Unclear	Two interventions in two months	Static	Email	1	KAB (Knowledge-Attitude-Behaviour model)	↑ Alcohol consumption quantity & frequency	Unclear
3	Bendtsen et al., 2015	Gender, Age Alcohol consumption	Single session	Static	Website	3	-	↑ Total Alcool consumption per week	High
4a.1	Berman et al., 2019	Real-time estimated eBAC levels (alcohol consumption, gender, weight)	Real time, as much as participants decide	Dynamic	Mobile app	1	TPB[a]	↑↑ eBAC levels	Unclear
4a.2	Berman et al., 2019	Real-time estimated eBAC levels (alcohol consumption, gender, weight) Drink event planned vs real	Real time, as much as participants decide	Dynamic	Web based app	2	-	↑↑ eBAC levels	Unclear
4b	Berman et al., 2019	Alcohol consumption Gender Weight Reported risky situations	As much as participants decide	Dynamic	Web based app	2	-	↑ Reduced drinking days	Unclear
5	Bertholet et al., 2015	Alcohol consumption Alcohol related consequences	Single session	Static	Website Email	4	-	↑↑ Number of drinks per week	Low
6	Bertholet et al., 2019	Gender, Age Alcohol consumption	5 modules As much as participants decide	Dynamic	Mobile app	4	SNT Risk perception	≈	High
7	Bischof et al., 2008	Alcohol consumption Self-report efficacy	Computerized feedback once; Brief counselling	Dynamic	Computer	1	TM[a]	↑↑ Reduction at risk and binge drinking	Low

#	Authors, year	Tailoring based on	Dosage Intensity/ duration	Static or Dynamic	Mode of Delivery	# Tailoring tactics	Use of theory	Intervention effect	Overall risk of bias assessment
			sessions 1, 3, 6 months each for 30-40 min						
8	Blankers et al., 2011	Alcohol consumption Drinking related contexts and inner states Dinking goal	As much as participants decide; suggested daily for minimum 4 wks	Static	Website	2	CBT MI	↑↑ Standard drinks	High
9	Boon et al., 2011	Gender, age Alcohol consumption Self-efficacy, attitude, Readiness to change	Single session ~10 min	Static	Website	3	TM[a]	↑↑ Alcohol consumption	High
10	Boβ et al., 2018	Alcohol consumption	5 modules, one per week	Static	Web-based Computer or Mobile digital device	2	TM HAPA PST	↑↑ Standard units of alcohol	High
11	Brendryen et al., 2017	Gender Alcohol consumption	62 sessions 6 mths Each session 3-10 min = ~10 hours	Dynamic	Web-based Messaging	2	SRT[a]	↑ Average drinks per week	High
12	Brendryen et al., 2014	Gender Alcohol consumption Drinking goal	62 sessions 6 mths Each session 3-10 min = ~10 hours	Dynamic	Web-based Messaging	2	TM[a] SRT[a]	↑↑ Standard units of alcohol	High
13	Brief et al., 2003	Gender Alcohol consumption Drinking goals Coping plans PTSD symptoms	8 modules 8 Wks ~20 min/	Dynamic	Web-based	4	-	↑↑ Alcohol consumption	High
14	Butler et al., 2003	Alcohol consumption Readiness to change Preferred language	Single session	Static	Computer (health education kiosk) Print . Op	3	TM[a]	≈	High
15	Butler & Correia, 2009	Gender, weight Alcohol consumption Alcohol related problems	Single session Avg =11.11 min	Static	Computer Printed	2	-	↑↑ Alcohol use days, binge drinking days, standard drinks	Unclear

#	Authors, year	Tailoring based on	Dosage Intensity/ duration	Static or Dynamic	Mode of Delivery	# Tailoring tactics	Use of theory	Intervention effect	Overall risk of bias assessment
16	Cadigan et al., 2017	Normative perceptions Weekly time allocation diff domains Gender, weight Alcohol consumption Time spent drinking Alcohol related problems	Single session	Static	Messaging	4	-	↑↑ Number of drinks consumed, eBAC	Unclear
17	Carey et al., 2017	Normative perceptions Gender Readiness to change Alcohol and drug use Alcohol related problems Risk factors	Single session 20 min	Static	Computer	4	TM[a]	↑↑ Heavy drinking episodes & peak drinking quantity	High
18	Chiauzzi et al., 2005	Gender, race, ethnic group Alcohol consumption Beliefs rel. alcohol Lifestyle Drinking risks and consequences Readiness to change	4 wks/ 4 sessions 20 min sessions Risk factors - As much as participants decide	Dynamic	Web-based Printed -Op	2	-	↑↑ Subgroups: women, persistant heavy drinkers and low motivation drinkers	High
19.1	Collins et al., 2013	Alcohol consumption Normative perceptions Gender	Single session	Static	Web based	1	SLT[a]	↑↑ Drinking frequency & alcohol related problems	Unclear
19.2	Collins et al., 2013	Advantages and disadvantages of maintaining and reducing alcohol consumption, likelihood and importance of each	Single session	Static	Web based	2	DMT	↑↑ Drinking quantity, frequency & alcohol related problems	Unclear
20	Crombie et al., 2015a	First name Target group	12 wks 112 text messages 160 characters per message	Static	Mobile application Messaging	2	HAPA[a]	↑ Binge drinking	Low
21	Cucciary et al., 2013	Gender, age, weight Alcohol consumption	Single session 10-15 min	Static	Computer Printed	3	-	↑↑ Fewer drinking days	Unclear

#	Authors, year	Tailoring based on	Dosage Intensity/ duration	Static or Dynamic	Mode of Delivery	# Tailoring tactics	Use of theory	Intervention effect	Overall risk of bias assessment
		Alcohol related problems Motivation to change Liver Diseases						Unhealthy drinking days	
22	Cunningham et al., 2015a	Gender Readiness to change Alcohol consumption	Single session	Static	Electronic (offline, Facebook-styled program delivered in touchscreen tablets with audio Printed	3	-	↑↑ Alcohol consumption, consequences & prescription drug use	Low
23.1	Cunningham et al., 2015b	Sex, age Alcohol consumption Alcohol consequences	Single session	Static	Website	3	-	↑↑ Alcohol consumption	Unclear
23.2	Cunningham et al., 2015b	Alcohol consumption Alcohol consequences	Single session	Static	Website	2	-	↑↑ Drinks in a typical week & AUDIT-C score	Unclear
23.3	Cunningham et al., 2015b	Sex, age Alcohol consumption	Single session	Static	Website	1	-	≈	Unclear
24	Cunningham et al., 2009	Sex, age, country, weight Alcohol consumption Psychological Alcohol consequences	Single session 10 min	Static	Website	3	-	↑↑ Weekly drinking quantity	High
25	Cunningham et al., 2012	Sex, age, country, Alcohol consumption	Single session	Static	Website	3	-	≈	Unclear
26	Cunningham et al., 2017	Sex, age, country, weight Alcohol consumption	Single session	Static	Website	1	-	↑ Number of drinks per week	Unclear
27	Delrahim-Howlett et al., 2011	Race/ethnicity Alcohol consumption Normative perceptions	Single session	Static	Website Printed	3	-	≈	Low

#	Authors, year	Tailoring based on	Dosage Intensity/ duration	Static or Dynamic	Mode of Delivery	# Tailoring tactics	Use of theory	Intervention effect	Overall risk of bias assessment
28	Deluca et al., 2020	Alcohol risks knowledge Alcohol consequences Alcohol consumption	As much as participants decide	Dynamic	Website or Mobile application	2	-	≈	High
29	Doumas et al., 2010	Sex, age Alcohol consumption Alcohol consequences and risks Normative perceptions	Single session 30 min	Static	Website	3	-	↑↑ Subgroup: high risk students – weekly drinking frequency of drinking to intoxication and peak alcohol consumption	Unclear
30	Doumas et al., 2011	Sex, age Alcohol consumption Alcohol consequences and risks Normative perceptions	Single session 30 min	Static	Website	4	-	↑↑ Subgroup: high risk students – heavy drinking and alcohol related consequences	High
31	Duroy et al., 2016	Alcohol consumption Readiness to change	Single session 20 min Phone reinforcements 1 and 3 months	Dynamic	Computer Website Audio call	3	-	≈	High
32	Ekman et al., 2011	Gender, age, weight Alcohol consumption	Single session	Static	Website	2	-	↑ Average weekly consumption over time	High
34.1	Gajecki et al., 2014	Gender, weight Alcohol consumption	Events where alcohol would be consumed	Dynamic	Mobile application	2	TPB[a]	≈	High
34.2	Gajecki et al., 2014	Gender, weight Alcohol consumption Personal plan for eBAC before drink	Events where alcohol would be consumed	Dynamic	Mobile application	4	TPB[a]	≈	High
35	Geisner et al., 2015	Gender Alcohol consumption Alcohol consequences Protective behaviour strategies Normative perceptions	Single session	Static	Website	4	SNT[a]	≈	Low

#	Authors, year	Tailoring based on	Dosage Intensity/ duration	Static or Dynamic	Mode of Delivery	# Tailoring tactics	Use of theory	Intervention effect	Overall risk of bias assessment
		Depression symptoms							
36	Gilmore et al., 2015	Gender Alcohol consumption Normative perceptions	Single session	Static	Website	3	SNT[a]	↑↑ Drinking norms	High
37	Guillemont et al., 2017	Gender, age Alcohol consumption Alcohol cravings Wellbeing	As much as participants decide	Dynamic	Website	4	-	↑↑ Weekly alcohol intake	High
38.1	Hansen et al., 2012	Gender Alcohol consumption	Single session	Static	Website	2	SRT[a]	↑ Drinks per week	Unclear
38.2	Hansen et al., 2012	Alcohol consumption	Single session	Static	Website	3	SRT[a]	↑ Drinks per week	Unclear
39	Hasin et al., 2013	Alcohol consumption Reasons for drinking/not drinking Drinking goals	Daily call 1 mth, 1-3 min Ind. Counselling session 10-15 min (Repeated)	Dynamic	Call Human interaction	2	-	↑↑ Number of drinks per drinking day	High
40	Hedman & Akagi, 2008	Alcohol consumption Drinking goals	12 sessions 6 wks	Dynamic	Email	3	-	↑↑ Number of drinks & binge drinking	High
41	Hester & Delaney, 1997	Gender, weight Alcohol consumption Drinking goals	8 sessions 10 wks Each session between 15-45 min	Dynamic	Computer Print	2	-	↑↑ Drinks per week, drinks per drinking days & peak BACs	Unclear
42	Hester et al., 2005	First name Gender, weight Alcohol consumption Alcohol related problems Dependence symptoms Readiness to change Goal setting	3 modules Avg=90 min	Dynamic	Computer Print	5	-	↑↑ Drinks per week, drinks per drinking days & peak BACs	Unclear
43a	Hester & Campbell, 2012 (Study 1)	Gender, weight Alcohol consumption Alcohol related problems Readiness to change	3 modules ~35 min	Dynamic	Computer	3	MI	↑↑ Average number of drinks in heavy episode	High

#	Authors, year	Tailoring based on	Dosage Intensity/ duration	Static or Dynamic	Mode of Delivery	# Tailoring tactics	Use of theory	Intervention effect	Overall risk of bias assessment
43b	Hester & Campbell, 2012 (Study 2)	Gender, weight Alcohol consumption Alcohol related problems Readiness to change	3 modules ~35 min	Dynamic	Computer	3	MI	↑↑ Peak BAC & heavier episode peak BACs	Unclear
44	Jo et al., 2019	Gender, age Alcohol consumption Self-efficacy to control drinking Severity of problematic drinking Goal setting Readiness to change	2 sessions 1st 15-20 min 2nd 8-10 min (4th wk)	Dynamic	Website	4	-	↑↑ Alcohol consumption past week, binge drinking & AUDIT-K score	Low
45	Khadjesari et al., 2014	Alcohol consumption	Single session	Static	Computer	2	MI CBT Behaviour self-control Relapse prevention	≈	Unclear
46	King et al., 2019	Alcohol consumption Normative perceptions Risk factors Alcohol expectancies Readiness to change	2 sessions	Dynamic	Fax Video call	2	-	≈	High
47	Kypry et al., 2004	Weight Alcohol consumption Normative perceptions	Single session	Static	Website	3	-	↑↑ Total consumption, heavy drinking episodes, alcohol related problems	Low
48.1	Kypry et al., 2008	Weight Alcohol consumption Normative perceptions	Single session 10 - 15 minutes assessment and personalised feedback Median 9.3 min	Static	Website	3	-	↑↑ Total consumption, frequency of drinking, academic problems	Unclear
48.2	Kypry et al., 2008	Weight Alcohol consumption Normative perceptions	3sessions: brief motivational intervention with booster sessions: 1 & 6 months	Dynamic	Website	3	-	↑↑ Total consumption, frequency of drinking, reduced episodic heavy drinking, academic problems	Unclear

#	Authors, year	Tailoring based on	Dosage Intensity/ duration	Static or Dynamic	Mode of Delivery	# Tailoring tactics	Use of theory	Intervention effect	Overall risk of bias assessment
49	Kypry et al., 2009	Sex, age, weight, height Alcohol consumption	Two sessions 1 mth interval 10 min	Dynamic	Website	2	-	↑↑ Frequency, quantity per drinking occasion, total consumption	Unclear
50	Kypry et al., 2013	Sex, age, weight, Alcohol consumption	Single session	Static	Website	2	-	↑↑ Frequency, quantity per drinking occasion, total consumption, academic problems	Unclear
51	Kypry et al., 2014	Sex, age, weight, Alcohol consumption	Single session	Static	Website	2	-	≈	Unclear
52.1	LaBrie et al., 2013	Sex, race/ethnicity, Greek status, weight Alcohol consumption Normative perceptions Alcohol risks	Single session	Static	Website Printed - Op	3	-	↑↑ Drinking days & peak number of drinks	High
52.2	LaBrie et al., 2013	Alcohol consumption Weight	Single session	Static	Website Printed - Op	2	SCT[a] SIT[a]	No info	High
52.3	LaBrie et al., 2013	Alcohol consumption Normative perception	Single session	Static	Website Printed - Op	2	SCT[a] SIT[a]	No info	High
52.4	LaBrie et al., 2013	Alcohol consumption Normative perception Sex	Single session	Static	Website Printed - Op	2	SCT[a] SIT[a]	No info	High
52.5	LaBrie et al., 2013	Alcohol consumption Normative perception Greek status	Single session	Static	Website Printed - Op	2	SCT[a] SIT[a]	No info	High
52.6	LaBrie et al., 2013	Alcohol consumption Normative perception Race	Single session	Static	Website Printed - Op	2	SCT[a] SIT[a]	No info	High
52.7	LaBrie et al., 2013	Alcohol consumption Normative perception Sex, Race	Single session	Static	Website Printed - Op	2	SCT[a] SIT[a]	No info	High
52.8	LaBrie et al., 2013	Alcohol consumption Normative perception Sex, Greek status	Single session	Static	Website Printed - Op	2	SCT[a] SIT[a]	No info	High
52.9	LaBrie et al., 2013	Alcohol consumption Normative perception Sex, Race, Greek status	Single session	Static	Website Printed - Op	2	SCT[a] SIT[a]	No info	High
53	LaLiberte, 2018	Name Gender, age	Single session 15-20 min	Dynamic	Computer	3	MI	≈	High

#	Authors, year	Tailoring based on	Dosage Intensity/ duration	Static or Dynamic	Mode of Delivery	# Tailoring tactics	Use of theory	Intervention effect	Overall risk of bias assessment
		Alcohol consumption Drinking goals							
54	Leeman et al., 2016	Sex, age, weight Alcohol consumption	Single session Avg=9 min	Static	Website	2	-	↑↑ Drinks per week & peak drinking	Unclear
55.1	Lewis & Neighbors, 2007a	Alcohol consumption Normative perception	Single session	Static	Computer Printed	2	SCT[a] SIT[a] SNT[a] SImpactT	↑↑ Alcohol consumption, perceived norms	Unclear
55.2	Lewis & Neighbors, 2007a	Gender Alcohol consumption Normative perception (Gender)	Single session	Static	Computer Printed	2	SCT[a] SIT[a] SNT[a] SImpactT	↑↑ Alcohol consumption (women only)	Unclear
56.1	Lewis et al., 2007b	Alcohol consumption Normative perception	Single session	Static	Computer Printed	1	SCompT SImpact	↑↑ Frequency	Unclear
56.2	Lewis et al., 2007b	Gender Alcohol consumption Normative perception (Gender)	Single session	Static	Computer Printed	1	SCompT SImpact	↑↑ Quantity & frequency	Unclear
57.1	Lewis & Patrick, 2014	Alcohol consumption Normative perception alcohol use	Single session	Static	Computer	2	SLT[a] SCT[a] SNT[a]	↑↑ Quantity & frequency	Low
57.2	Lewis & Patrick, 2014	Alcohol consumption Sexual behaviours Normative perception sexual behaviours	Single session	Static	Computer	2	SLT[a] SCT[a] SNT[a]	≈	Low
57.3	Lewis & Patrick, 2014	Alcohol consumption Sexual behaviours Normative perception alcohol use	Single session	Static	Computer	2	SLT[a] SCT[a] SNT[a]	↑↑ Frequency	Low
58	McCarty et al., 2019	Gender, Age Alcohol consumption Drinking goals	Single session	Static	Computer	2	-	≈	High
59	McPherson, 2012	Age, height, weight Alcohol consumption Age started drinking Family history alcohol problems	Single session 20-30 min	Static	Computer Printed – Op	5	HRT[a] MI SNT[a]	↑ Weekly & peak consumption	High
60	Moreira et al., 2012	Alcohol consumption	Single session	Static	Email	2	SNT[a]	≈	High

#	Authors, year	Tailoring based on	Dosage Intensity/duration	Static or Dynamic	Mode of Delivery	# Tailoring tactics	Use of theory	Intervention effect	Overall risk of bias assessment
61a	Murphy et al., 2010 (Study 1)	Alcohol related problems Perceived norms Positice expectancies Gender, weight Alcohol consumption	Single session 50-60 mon	Static	Computer	1	.	≈	Unclear
61b	Murphy et al., 2010 (Study 2)	Alcohol consumption Normative perception Alcohol related consequences Family risk	Single session Students asked to review Feedback for minimum 30 min	Static	Computer	3	MI	↑ Alcohol consumption	Unclear
62	Nayak et al., 2019	Alcohol consumption Goal setting	Single session 10 minutes	Static	Computer	4	-	↑↑ Alcohol use & heavy alcohol use	Unclear
63	Neighbors et al., 2004	Alcohol consumption Perceived norms	Single session	Static	Computer Printed	1	SNT[a]	↑↑ Alcohol consumption & perceived norms	Unclear
64	Neighbors et al., 2006	Alcohol consumption Perceived norms	Single session	Static	Computer Printed	1	SNT[a]	↑↑ Fewer drinks per week & perceived norms	Unclear
65.1	Neighbors et al., 2010	Alcohol consumption Perceived norms	Single session	Static	-	1	SCT[a] SIT[a] Self-categorization theory	≈	Low
65.2	Neighbors et al., 2010	Alcohol consumption Perceived gender specific norms	Single session	Static	-	1	SCT[a] SIT[a] Self-categorization theory	≈	Low
65.3	Neighbors et al., 2010	Alcohol consumption Perceived norms	Two sessions	Dynamic	-	1	SCT[a] SIT[a] Self-categorization theory	≈	Low
65.4	Neighbors et al., 2010	Alcohol consumption Perceived gender specific norms	Two sessions	Dynamic	-	1	SCT[a] SIT[a] Self-categorization theory	↑↑ Weekly drinking	Low
66.1	Neighbors et al., 2016	Gender Alcohol consumption	Single session	Static	Computer Printed	1	SNT[a]	↑↑	High

#	Authors, year	Tailoring based on	Dosage Intensity/ duration	Static or Dynamic	Mode of Delivery	# Tailoring tactics	Use of theory	Intervention effect	Overall risk of bias assessment
		Perceived norms Alcohol consequences						Drinks per week, in the past month & frequency	
66.2	Neighbors et al., 2016	Gender Alcohol consumption Alcohol consequences	Single session	Static	Computer Printed	1	SNT[a]	↑↑ Drinks per week, in the past month & frequency	High
67	Neumann et al., 2006	Alcohol consumption Readiness to change	Single session	Static	Computer Printed	4	-	↑↑ Alcohol use & at-risk drinking	High
68	Palfai et al., 2011	Gender, weight Alcohol consumption Alcohol consequences	Single session	Static	Computer	3	-	↑↑ Subgroup: high level of alcohol negative consequences- weekly alcohol use & episodic drinking	Unclear
69	Pedersen et al., 2017	Gender Alcohol consumption Perceived norms	Single session 5-10 min	Static	Computer Mobile	3	SNT[a]	↑↑ Drinks per week, drinks per occasion, binge drinking, alcohol consequences	High
70	Postel et al., 2010	Alcohol consumption Drinking goals	12 sessions during 3 mths 1-2 therapist contacts per wk Daily self-registration	Dynamic	Computer At-a-distance	3	CBT MI	↑↑ Weekly alcohol consumption	High
71	Ridout & Campbell, 2014	Alcohol consumption Perceived norms	3 sessions	Dynamic	Computer	4	SNT[a]	↑↑ Alcohol quantity and frequency	Low
72.1	Rocha, 2012	Alcohol consumption Readiness to change	Single session Questions asked after feedback to ensure they attended and understood the materials	Static	Email	1	SNT[a] SRT[a]	≈	High
72.2	Rocha, 2012	Alcohol consumption Weight Alcohol consequences	Single session Questions asked after feedback to	Static	Email	3	SNT[a] SRT[a]	≈	High

#	Authors, year	Tailoring based on	Dosage Intensity/ duration	Static or Dynamic	Mode of Delivery	# Tailoring tactics	Use of theory	Intervention effect	Overall risk of bias assessment
		Protetive factors	ensure they attended and understood the materials						
73	Rose et al., 2017	Alcohol consumption Readiness to change	Single session Avg=6.5 min	Static	Computer Call (Interactive Voice Response)	2	-	≈	High
74	Schulz et al., 2013	Alcohol consumption Predictors of behavior change (attitude, social influence, self-efficacy, planning)	3 sessions	Dynamic	Computer Printed - Op	4	ICM[a]	↑ Drinks per week	High
75.1	Sinadinovic et al., 2014	Gender, age, alcohol consumption, positive and negative aspects of alcohol use, readiness to change	Depends on the severity of alcohol use	Dynamic	Computer	4	MI	≈	High
75.2	Sinadinovic et al., 2014	Depends on the chosen modules	18 modules	Dynamic	Computer	1	CBT MI	↑ Alcohol use	High
76.1	Spijkerman et al., 2010	Gender, age, alcohol consumption, drinking motives, health risk status	Single session Avg=15 min	Static	Computer	2	SNT[a]	↑↑ Weekly drinking	High
76.2	Spijkerman et al., 2010	Gender, age, alcohol consumption, drinking motives, health risk status, peers alcohol consumption estimation	Single session Avg=15 min	Static	Computer	3	SNT[a]	↑↑ Weekly drinking	High
77	Suffoletto et al., 2014	Weekend drinking plans Binge drinking	12 weeks (Thursday & Sunday)	Dynamic	Messaging	2	HBM[a] TRA[a] Information Motivation Behavior Model	↑↑ Binge drinking days & drinks per drinking day	Unclear
79	Thomas et al., 2018	Alcohol consumption Drinking goals	6 wks 62 messages	Dynamic	Messaging	1	-	≈	High
80	Voogt et al., 2013a	Sex, weight Alcohol consumption Perceived social norms	Single session 20 min	Static	Computer	3	MI ICM[a] TM[a]	≈	High

#	Authors, year	Tailoring based on	Dosage Intensity/ duration	Static or Dynamic	Mode of Delivery	# Tailoring tactics	Use of theory	Intervention effect	Overall risk of bias assessment
		Drinking goals Difficult situations to resist alcohol					TSI		
81	Voogt et al., 2013b	Sex, weight Alcohol consumption Perceived social norms Drinking goals Difficult situations to resist alcohol	Single session 20 min	Static	Computer	3	MI ICM[a] TM[a] TSI TPB[a]	≈	Low
82	Wagener et al., 2012	Weight, gender Alcohol consumption Perception of drinking norms Alcohol dependence Alcohol related problems Perceptions of alcohol related risk Psychological distress Motivation to change	Single session ~45 min	Static	Computer Video call	2	-	↑ Not explicit	Unclear
83	Wallace et al., 2011	Gender, age, weight Alcohol consumption	1-h, 5-day and 4-week routes presented as options	Dynamic	Website	2	MI CBT	≈	Low
84	Wallace et al., 2017	Alcohol consumption	As much as participants decide	Dynamic	Website	3	-	Inconclusive	High
85	Walters et al., 2007	Gender, weight Alcohol consumption Alcohol consequences Normative perceptions Genetic risk alcoholism	Single session	Static	Website	3	MI SLT[a]	↑↑ Drinks per week, peak BAC	High
86	Walters et al., 2009	Gender, weight Alcohol consumption Alcohol consequences Normative perceptions Protective behaviors Readiness to change	Single session	Static	Computer	3	-	≈	Low
87	Walton et al., 2010	Alcohol consumption Alcohol consequences	~35 minutes	Unclear	Computer	3	MI	↑↑ Alcohol consequences	Unclear

#	Authors, year	Tailoring based on	Dosage Intensity/ duration	Static or Dynamic	Mode of Delivery	# Tailoring tactics	Use of theory	Intervention effect	Overall risk of bias assessment
88	Weaver, 2014	Frequency of aggression Consequences of fighting Gender, weight Alcohol consumption Alcohol consequences, dependence Normative perceptions Psychological distress Readiness to change	Single session ~45 minutes	Static	Computer Video call	3	-	↑↑ BACs on heaviest drinking day	Unclear
89	Wray, 2019	Alcohol consumption Sexual behaviors Readiness to change Change goals	Unclear ~33 minutes	Dynamic	Computer	3	MI	↑↑ Drinking days, Alcohol related problems	High
90	Wright, 2018	Gender, time, location Alcohol consumption, spending Consumption intentions and motivation	12 wks study Chose 6 weekends planned drinking Each night were sendt up to 23 SMS messages	Dynamic	Messaging	3	MI	≈	High
92	Zill et al., 2019	Alcohol consumption Drinking goals	4 modules Recommended 2 hour per wk	Dynamic	Computer Mobile	3	CBT	↑↑ Daily alcohol consumption, binge drinking days	High

Note. Intervention effect: (↑↑) Superior significant (intervention group superior to the control group with statistical significance); (↑) Superior non-significant (there are no differences in the results between intervention and control); (≈) No difference; (↓) Inferior (trend of superiority of the control group in relation to the intervention); Use of theory: **(BCT)** Behaviour change theory; **(CBT)** Cognitive-behavioural theory; **(DMT)** Decision-making theory; **(HAPA)** Health Action Process approach; **(HRT)** Harm Reduction Theory; **(HBM)** Health belief model; **(ICM)** I-change model; **(MIT)** Motivational interview; **(PST)** Problem solving theory; **(SCT)** Social cognitive theory; **(SCompT)** Social comparison theory; **(SIT)** Social identity theory; **(SLT)** Social learning theory; **(SNT)** Social norms theory; **(SRT)** Self-regulation theory; **(TM)** Transtheoretical model; **(TPB)** Theory of planned behaviour; **(TRA)** Theory of reasoned action; **(TSI)** Theory of social influence

[a] Included in the Behaviour Change Theory Database (https://theory-database.appspot.com/);

Use of theory

Most of the interventions (59%) were designed based on one or more theories (see detailed Table B3). In the majority of these interventions (76%) it was provided some kind of rationale for the choice of theory related with the tailoring. The maximum number of theories used in one study was five (Voogt et al., 2013b), while 30% of the interventions were based on a single theory. In total, 26 different theories were mentioned. On average 1.8 theories were mentioned per intervention.

Ten of these theories belong to the Behaviour Change Theory Database, with the Social Norms Theory ($n = 20$, 17%), Social Influence Theory ($n = 14$, 12%), Social Cognitive Theory and Transtheoretical Model (each mentioned in 7 interventions; 6%) being the most frequently reported ones. The great majority of the interventions based on Social Norms Theory (90%) provided a rational for the use of this theory.

Links between tailoring and other intervention components

All studies reported tailoring mechanisms and tactics and most reported to some extent the information on how these tactics were implemented (i.e., how they were translated into functionalities and content presented to users), what were the theoretical principles in which interventions were based on, how these tactics were delivered (MoD) and with what dose (see Figure 1). All, except one intervention, reported the individual factors in which tailoring was based on. In 46% of the studies the links between theory and tailoring were presented, in 14% of the interventions a theory was mentioned but no relation was made with any tailoring component. MoD was explicit in all interventions except one. Regarding the dose, only 29% of the interventions reported the number of contacts, frequency and duration of each contact.

Figure 1

Percentage of components reported based on tailoring descriptions
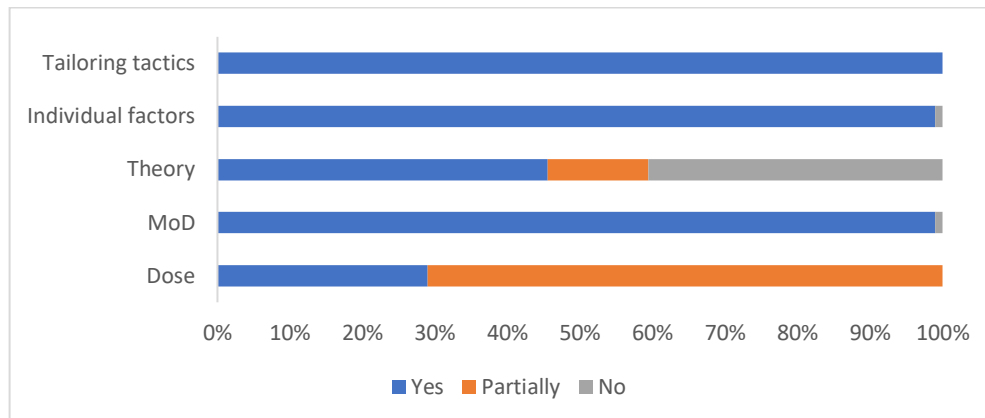
Intervention effect

Many of the interventions (54%) showed a superior significant effect of the intervention group compared with the control group. In 26% there was no difference and in 12% the results were superior but not significant. In one trial the results were inconclusive (Wagener et al., 2012). In LaBrie et al. study (2013) the results of 8 interventions were presented in an aggregated form.

The analysis between intervention' characteristics and its effects revealed a significant heterogeneity. For example, among interventions in which tailoring was dynamic, 59% had superior significant effect, a very similar percentage to interventions in which tailoring was static (58%). In terms of dosage, 57% of intervention with a single session showed a superior significant effect versus 66% of interventions with multiple sessions. There was no clear outcome in interventions that were based on the same theory (e.g., 65% of interventions using Social Norms Theory had a superior significant effect, in 5% the effect was superior but not significant and 30% showed no difference), or even between interventions with the same name (e.g., 68% of interventions designated by PNF showed a superior significant effect, in 4% the effect was superior but not significant and 28% revealed no difference). An analysis between the number of tailoring tactics and interventions effects suggests that the usage of a higher number of tactics might have a positive impact. In 38% of interventions that used a single tactic there was a superior significant impact while this percentage increases in interventions using two, three and four tactics (54%, 62% and 67% respectively).

Discussion

As tailoring may enhance the impact of messages by altering attention and influencing the depth and nature of message processing (Hawkins et al., 2008), we sought to further advance the research about the 'black box' of tailoring. The main objective of this study was to identify the various components used in tailored digital behaviour change interventions for reducing harmful and hazardous alcohol consumption, by providing an overview of the current state of DHBCIs reporting. For this purpose, a secondary analysis of a systematic review on DHBCIs (Beyer et al., 2022) was performed. This analysis included 89 articles describing a total of 118 interventions. The methodical extraction and classification of the intervention components from the identified studies allowed the identification of the gaps in the literature and provided new insights on the necessity of using formal ways of reporting intervention components to facilitate the accumulation of evidence and inform future intervention development.

Currently, comparison across studies is extremely difficult due to the high heterogeneity of the several intervention components, such as target, MoD, dosage, tailoring tactics, length of follow-up, among others. Very few studies systematically described the links between tailoring techniques and other intervention components. Underreporting of intervention content undermines the comparability across interventions, as well as their replication. Findings have been inconsistent, which is not surprising given the wide range of heterogeneity in the literature. Tailored interventions have yielded a vast array of results across studies, ranging from no effects in some studies to minor or substantial effects on others.

Even though Hawkins et al. (2008) have proposed a tailoring categorization, none of the articles analysed referred specifically to it. One of the personalisation tactics conceptualized by these authors, *raising expectations,* was not employed/described in a single intervention. A popular strategy in customised health communication initiatives, tailored *evaluative or motivational feedback*, which adds a level of interpretation, judgment, and/or inference regarding an individual's attitudes, beliefs, or behaviour (Hawkins et al., 2008), was the least used feedback tactic (in 58% of the interventions). Future research should examine personalisation tactics to understand their impact on specific contexts and populations.

The most common recruitment setting was the university (46%). Correction of normative misperceptions through personalised normative feedback (PNF) is a major focus of

many college drinking intervention research, as literature demonstrates a strong association between perceived norms and alcohol use in college populations (Neighbors et al., 2006). PNF was created to draw attention to two pieces of information about normative beliefs that are known to affect drinking behaviour of participants who engage in heavy drinking: (a) other students drink less than the participant drinks (social comparison information), and (b) other students drink less than the participant thinks they drink (normative misperception correction) (Neighbors et al., 2016).

Further refining of some the tailoring strategies and tactics can provide greater clarity to future analyses. Harrington & Noar (2012), based on Hawkins et al. (2008) and Dijkstra (2008) conceptualisation, suggested a distinction between *comparative-normative feedback* and *comparative-progress feedback*. The first comparing a participant's data to those of their peers while in the second, the comparison was made to a previous time point. We would like to propose that the tactic *comparative-normative feedback* will be split in two. *Comparative feedback* would include a comparison of an individual's conduct to the real norm without explicitly correcting any normative misconceptions while, *normative feedback* would be delivered to participants in a way that specifically corrects false drinking norms' perceptions. This feedback includes own self-reported drinking, their perception of others' drinking, and the actual drinking rates for a referent. Furthermore, the choice of the reference group can vary in the degree of specificity (e.g., peers in general versus same-sex peers or first year graduate students).

According to Noar et al. (2007) meta-analysis of tailoring studies, employing theoretical constructs enhances tailoring effects. Hawkins et al. (2008) state that the choice of certain tailoring strategies and tactics should be deliberate, informed by theory and/or empirical research, and with consideration of the benefits and drawbacks of each strategy. Still, in the current review, only 59% of the interventions mentioned at least one theory and 45% of interventions provided an explicit theoretical rational. Furthermore, for the same intervention designation, inconsistencies have been detected in the reporting of tailoring strategies and tactics (e.g., Cunningham et al., 2009, 2017), as well as theories (e.g., Walters et al., 2007, 2009).

Most studies relied on static written information and the majority of the interventions (60%) were static (i.e., feedback was based on a single assessment). This suggests that the technological potential of DHBCIs is not being used to its fullest. The technological capabilities made possible by digital platforms have enormous potential for improving user

engagement and boosting the effectiveness of complicated and dynamic intervention strategies. By allowing for more granular testing, optimization designs like micro-randomized trials may help to fully realize the potential of DHBCIs (Encantado et al., 2022).

Additionally, the information on the dose of the interventions was not systematised in the publications that were evaluated. Frequency was absent in most cases and most of the interventions with a single session had no mention of their duration. Underreporting of interventions' dosage has also been described in a recent scoping review targeting physical activity (Encantado et al., 2022). In terms of effect, 66% of interventions with multiple sessions showed a superior significant effect versus 57% of intervention with a single session. Previous findings suggested that interventions with multiple interactions were more effective than one-off interventions (NICE, 2020; Noar et al., 2007).

The high heterogeneity of the several intervention components, its underreporting and lack of use of standardised approaches makes it difficult to conclude if there are links between intervention' characteristics and intervention' effects. This review found no relation between *dynamic* versus *static* tailoring and intervention effects. Previous studies have shown inconsistent results. In Krebs et al. (2010) dynamic tailoring outperformed static tailoring for all interventions using either single or multiple MoDs, while Lustria et al. (2013) discovered that studies using a single evaluation were marginally, but not significantly, more effective than trials using repeated assessments throughout time.

To the best of our knowledge, this is the first review to specifically map out how elements stated above are combined in tailored DHBCIs targeting hazardous and harmful alcohol consumption.

Strengths and limitations

The thorough classification of DHBCIs components using existing taxonomies and ontologies is a key strength of this secondary analysis, helping to identify knowledge gaps and enhance intervention reporting and design. Through this analysis, we were able to identify two major gaps in the DHBCI literature. First, given the high heterogeneity with which intervention components are described, it is challenging to extract information in a systematic and objective manner. Second, even when the DHBCIs components were reported, the links between them were not sufficiently explained. Regardless of whether the intervention is effective or not, without knowing the connections between the components, it cannot be determined with sufficient certainty why the intervention outputs are what they are. In order

to understand what works, for whom, when and why, researchers need standardised approaches to report interventions' components (Marques et al., 2021; Michie el al., 2021). The ongoing efforts in behavioural science to create standardised tools (e.g., ontologies and taxonomies) for creating and reporting digital intervention content will make a significant contribution to the identification of which intervention components affect intervention outcomes.

It was possible to build from a recent systematic review (Beyer et al., 2022) focusing the analysis on the tailoring components. However, the sophistication of tailoring has been evolving in recent years enhanced by digital and AI technology. A limitation of this review is the exclusion of trials published after 2020. In terms of data extraction, the fact that inter-rater reliability was not calculated might constitute an additional limitation. However, extraction of 20% of the studies by a second researcher and discussion of disagreements through an iterative process, was done in several rounds until consensus was reached. Gathering information from supplementary papers, whenever the articles cited other studies, protocols, or trial registrations for additional details on the intervention's characteristics, is considered a strength.

Despite the conceptualisation of tailoring in an extensive body of literature (Hawkins et al., 2008), there is no established classification system for the characteristics of tailoring. This endeavour is now being pursued by the Human Behaviour Change Project working group (Michie et al., 2021).

According to Kreuter et al. (1999), tailoring is any combination of information or change tactics meant to reach a single individual and based on attributes specific to that individual, relevant to the outcome of interest, and obtained from an individual assessment. Hawkins et al. (2008) pointed out that there is a need to understand the impact of individual assessment on tailoring outcomes. Individual-based assessments are essential to tailored interventions since they require knowledge about individuals and are probably most effective when this information is thorough and pertinent to targeted behaviours. However, these evaluations may have an impact on behaviour (e.g., increasing self-monitoring). The results of tailored interventions may be underestimated because in the majority of randomised trials, the comparison groups also completes the same potentially reactive assessment. However, if the comparison group is not assessed, the difference may be overestimated. From the 89 studies covered by this review only three (Gilmore et al., 2015; Wagener et al., 2012 and Wright et al., 2018) incorporated two control groups: a full assessment control, in which participants

completed the same assessment as those in the intervention condition, and a minimal assessment condition to investigate assessment reactivity and weather completing assessments alone can affect drinking behaviour.

Future studies

In order to advance the science of tailoring within the context of DHBCIs, and based on the literature gaps identified above, recommendations for future research include: enhancing research designs (e.g., use tailoring vs. generic control group) and methodology (e.g., use the tailoring strategies and recommendations advised in this field); determine the timing and extent to which assessments impacts processing, intermediate behaviours, and outcomes; use available tools (i.e., taxonomies and ontologies) in order to develop interventions in a clearer and more rigorous way, impacting clinical practice by improving the quality of interventions.

To facilitate the design of interventions, as well as their reporting, replication and implementation, it is essential to establish a standardised and accepted classification of the tailoring characteristics. This task is currently being pursued by the Human Behaviour Change Project working group (Michie et al., 2021). These standardised classifications should be used in literature reviews to facilitate information sharing.

There will be more opportunities to provide tailored health messages in the future thanks to technological advances in interactive communication technologies. The potential to tailor messages on different kinds of variables is practically endless but it is essential to continue the process of discovery of how tailoring works. For example, is tailoring more effective for some behaviors than others? For certain populations? What is the optimal dose model for tailoring? How many assessments are required, and for how long, in order to get the best results? What variables are most important to tailor on? These are some of the questions to address in future studies.

Conclusions

This secondary analysis of a systematic review (Beyer et al., 2022) identified which core components of tailored DHBCIs for reducing harmful and hazardous alcohol consumption are reported, the relationships between the tailoring mechanisms and tactics, and the depth of the reporting procedures. To the extent of our knowledge, this is among the first attempts to comprehensively characterise a wide variety of these DHBCIs' components and

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determine which domains the intervention development and reporting methods need additional focus.

This work helps us understand what is being done with regard to DHBCIs for hazardous and harmful alcohol consumption and what needs to be addressed in future studies by identifying the degree to which components are appropriately defined and the heterogeneity of this reporting methods across studies. The many objectives and tactics hidden in the 'black box' of tailoring require very different types of investigation. Tailored DHBCIs have a great potential as a tool for helping meet important public health objectives, both in alcohol consumption reduction and other health related behaviours. The characteristics of tailoring should be the focus of the research questions: the specific cognitive and behaviour determinant goals, as well as the methods and techniques used to reach them.

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Appendix A - Extended literature review

Alcohol abuse is linked to more than 200 diseases and the burden of disease is greater than that brought on by many other risk factors and illnesses at the top of the global health priority list (World Health Organization, 2019). Digital health behaviour change interventions (DHBCIs) have been found to be both more cost-effective and potentially more widely applicable than face-to-face brief interventions (Cunningham & van Mierlo, 2009; Gulliver et al., 2010; Lintvedt et al., 2013). There is some evidence that digital and mobile health interventions can help people reduce their alcohol intake (Black et al., 2016; Kaner et al., 2017; Beyer et al., 2022).

The enhancement of digital health interventions through tailoring (i.e. 'any combination of strategies and information intended to reach one specific person, based on characteristics that are unique to that person, related to the outcome of interest and derived from an individual assessment' (Kreuter et al., 1999, p. 277) is supported by recent systematic reviews across a range of illnesses and patient populations (Lustria et al., 2009, 2013; Morrison, 2015). The development and evaluation of tailored digital interventions has been focusing on certain modifiable behaviours more than others (e.g., physical activity) (Encantado, 2022; Gal et al., 2018; Lustria et al., 2013). Compared to generic, non-personalised health messages, tailored ones command more attention and are more likely to be read, elaborated on, recalled, and comprehended (Lustria et al., 2009, 2016; Ryan et al., 2019). However, prior research on tailored health interventions has mostly concentrated on determining whether tailoring is effective. A deeper analysis of the tailoring strategies and tactics employed, as well as its relation with other interventions characteristics, will therefore be helpful to inform the development of future digital health interventions.

This secondary analysis, of a recent literature review on interventions for reducing hazardous and harmful alcohol consumption (Beyer et al., 2022), will cover, relevant facts of alcohol consumption and its impact, the role of behaviour change interventions to address modifiable behaviours like alcohol intake and succinctly describing behavioural theories and interventions. It will then focus on one development that appears promising for scalable, effective interventions: the use of digital and mobile tools in the delivery of tailored interventions.

Alcohol consumption and its impact

The harmful use of alcohol is one of the main risk factors for poor health worldwide, ranking seventh among all risk factors for deaths and disability. In 2016, it caused around 3 million deaths being responsible for 5.1% of the global burden of disease as measured in disability-adjusted life years (DALYs - this is, the number of years of life lost due to premature death and time spent not being in good health). The percentage of all deaths and DALYs caused by alcohol use were highest in the European Region, where alcohol intake was responsible for 10.1% of all deaths and 10.8% of all DALYs (Griswold et al., 2018; WHO, 2019).

Harmful alcohol usage outweighs those brought on by numerous other risk factors and illnesses at the top of the global health priority list, having been related to more than 200 diseases. Alcohol consumption has a bigger mortality impact than tuberculosis (2.3%), HIV/AIDS (1.8%), diabetes (2.8%), hypertension (1.6%) and digestive illnesses (4.5%). Besides, alcohol consumption may have negative effects on attention, cognition and dexterity, increasing the risk of intentional (e.g., falls, burns, poisoning and traffic accidents) and unintentional injuries (e.g., suicide, interpersonal violence). In 2016, injuries accounted for 28.7% of alcohol-related deaths, followed by digestive illnesses (21.3%), cardiovascular illnesses (19%), infectious diseases (12.9%), and malignancies (12.6%). Around 40% of alcohol related DALYs are caused by injuries, while about 49% are caused by non-communicable and mental health problems (WHO, 2019).

However, only a fraction of all alcohol-related damages is health-related. It also results in considerable social and financial losses, including expenditures for the court system, decreased productivity at work and unemployment, as well as expenses for pain and suffering. Drinking can harm not just the drinker, but also others around, including members of the household, friends, family and strangers. The physical and mental health issues of those close to the drinker are usually disregarded, and there is no data for them to be included in these global figures (WHO, 2019; 2021).

Alcohol affects younger people more severely than older people and it is responsible for 13.5% of all deaths in people between the ages of 20 and 39. Results of school surveys show that alcohol consumption begins early in life, even before the age of 15 in many countries. Alcohol usage among 15-year-old can range from 50 to 70%, with very little

variation between boys and girls. More than a quarter (26.5%) of teenagers (between 15 and 19 years old) worldwide are drinkers (Griswold et al., 2018; WHO, 2019).

The most crucial elements of drinking are a hazardous volume of consumption (more than two drinks - 24 grams of ethanol, on average, per day) and if and to what extent there is heavy episodic drinking (HED; drinking about five or more drinks – approximately 60 grams of ethanol) (WHO, 2019). The number of standard drinks per week that caused the least amount of harm to all health outcomes was zero (Griswold et al., 2018). However, there has been no improvement in the world's overall per capita alcohol intake. An average daily consumption of 32.8 grams (40 grams among men) carries serious health concerns, making a top priority for worldwide action lowering alcohol consumption among drinkers. With 3 million alcohol-related deaths in 2016 and well-documented detrimental effects on people's health and well-being, there is a public health responsibility to intensify and maintain efforts to minimize alcohol's harmful use globally (WHO, 2019). Policymakers are urged to use measures that have proven to be efficient and affordable to lessen the burden of unhealthy alcohol usage. One of two indicators for the Sustainable Development Goals' (SDGs) health aim is the amount of alcohol consumed per capita annually in litters of pure alcohol. The establishment of screening and brief psychosocial intervention programs for hazardous and harmful drinking in health services is one of the proposed initiatives by the World Health Organization (2017; 2019; 2021).

Behaviour change interventions

There was a significant shift in the 20th century on the factors contributing to the global burden of disease as adult non-communicable diseases became the most responsible for adult premature death and morbidity. Reducing the burden of disease in the 21st century will require changes, at the population level, in modifiable behaviours (Hagger et al., 2020).

Behaviour change interventions (BCIs) are 'policies, activities, services or products designed to induce or support people to act differently from how they would have acted otherwise' (Michie et al., 2017, p.2). They comprise attempting to change either the characteristics of the target population (in terms of their knowledge, beliefs, skills, habits or feeling), their social or physical environment, or both (Michie et al., 2017). The development of behaviour change interventions can be an effective and cost-effective solution to reduce alcohol consumption as interventions that can produce small changes in significant health behaviours can result in substantial public health improvements (National Institute for Health

and Care Excellence 2007; 2014). However, changing one's behaviour is difficult. Those interventions need to be practical, realistic, acceptable, safe, equitable and inexpensive (Michie et al., 2014). Research examining the creation, assessment, and use of behaviour change interventions, as well as evidence synthesis, show a startling variation in effectiveness between studies (Flodgren et al., 2017; NICE, 2020) requiring a deeper analysis of tailored interventions.

If the science of behaviour change is to provide meaningful solutions to those tasked with addressing behaviour-related issues, it is essential that knowledge be developed on the methods that are most optimally effective and reliable in changing behaviour, as well as the factors that determine their effectiveness. Research findings have the potential to be an essential resource in the development or selection of BCIs, but this information needs to be synthesized and evaluated (Hagger et al., 2020). The National Institute for Health and Care Excellence (NICE, 2014) makes recommendations on individual-level BCIs to lower alcohol consumption. Behaviour change interventions need to incorporate techniques that have been demonstrated to be successful at altering behaviour (NICE, 2007).

The contexts and evaluation methods of behaviour change interventions are heterogenous, making it challenging to synthesize the available data and offer suggestions for actual policy and practice. Improving the effects of BCIs requires the specification of all features consistently and in great detail (like, intervention content, mode of delivery, mechanism of action, context) (Marques et al., 2021; Michie el al., 2017). Therefore, the creation of formal frameworks for accurately and succinctly describing behavioural theories and interventions are essential (Michie el al., 2021).

Behavioural interventions' content analyses have yielded ground-breaking research that aimed to identify the methods or techniques used to change behaviour (Michie et al., 2012, 2013). The term behaviour change technique (BCT) refers to an observable, replicable, and irreducible component of an intervention intended to change a specified behaviour. The technique can be postulated to be an active ingredient within the intervention and be used alone or in conjunction with other BCTs (Michie et al., 2020). The creation of taxonomies of BCTs is the result of conceptual work and reviews of behavioural intervention research. These taxonomies define the distinct, separable techniques that serve as the fundamental 'building blocks' of behavioural interventions, come up with a standard vocabulary to describe behavioural interventions, and provide a formal system for categorizing them (Hagger et al., 2020; Michie et al., 2021). Having a set of standardized and operationalized

BCTs facilitates design interventions, reporting, replication, and implementation (Marques et al., 2021; Michie et al., 2012). One of the first stages of a program to construct a global taxonomic classification system for BCTs was conducted by Michie et al. (2012). The resulting taxonomy, consisting of forty-two BCTs, was applied to interventions to reduce excessive alcohol consumption and the associations between the BCTs and effectiveness were investigated using meta-regression. The authors concluded that, in brief interventions, promoting self-monitoring was reliably associated with greater intervention effectiveness.

The widely used Behaviour Change Techniques Taxonomy (BCTTv1), developed by Michie et al. (2013), is one of the previously established classification systems for defining behaviour change techniques. It consists of a comprehensive and consensual hierarchical structured taxonomy of behaviour change techniques resulting in 93 clearly defined, non-redundant BCTs, grouped into 16 clusters. This taxonomy established the groundwork for the systematic and reliable characterization of behaviour change interventions, allowing the identification of active ingredients within intervention components, and the conditions under which they are effective.

To continue to build the science of human behaviour change, the Human Behaviour-Change Project's (HBCP) is developing a BCI knowledge system. Its overarching goal is to automate the gathering, synthesis, and analysis of evidence to quickly respond to inquiries from decision-makers, practitioners, and anyone who are interested in answers to questions like '*what works, compared with what, how well, with what exposure, with what behaviours (for how long), for whom, in what settings and why?*'. To permit aggregation and semantic querying, evidence must be organised ontologically, this is, linked to a common formal description of entities and relationships that captures domain knowledge. The upper level of the Behaviour Change Intervention Ontology (BCIO) provides a systematic way of describing and connecting elements in the field of behaviour change interventions. It is made up of several linked lower-level ontologies that work together to produce a composite whole. The upper level serves as the organising structure, and the lower-level ontologies' respective entities fill it out (Marques et al., 2021; Michie et al., 2017, 2021). Content analysis and narrative research synthesis will support the lower-level ontologies development and adjustment.

Table A1

Glossary of terms

Term	Definition	Source
Behaviour Change Intervention (BCI)	A product, service, activity, or structural change, intended to achieve behaviour change. It can be specified in terms of the content of the intervention and the way this is delivered	Michie et al., 2017
Behaviour Change Intervention Dose (BCI dose)	An attribute of BCI content that is its amount or intensity.	Michie et al., 2021
Behaviour Change Intervention Mode of Delivery (BCI mode of delivery)	An attribute of a BCI delivery that is the physical or informational medium through which a BCI is provided	Michie et al., 2021
Behaviour Change Technique (BCT)	The smallest component of an intervention compatible with retaining the postulated active ingredients and can be used alone or in combination with other BCTs.	Michie et al., 2017
Behaviour Change Techniques Taxonomy version 1 (BCTTv1)	A hierarchical classification system (taxonomy) for reliably specifying intervention components in terms of 93 well-defined behaviour change techniques (BCTs), organised into 16 groupings.	Michie et al., 2017
BCI ontology (BCIO)	An ontology that represents entities and relationships related to BCI evaluations and their reports	Michie et al., 2017
Outcome	Absolute numerical value of target behaviour associated with a BCI scenario	Michie et al., 2017

Digital behaviour change interventions

Behaviour change interventions to influence health behaviours can be delivered via a digital or mobile platform as a direct interface with participants - Digital health behaviours change interventions (DHBCIs). It includes the use of hardware, electronic devices (e.g., smartphones, smartwatches, wearable devices), software (e.g., apps, computer programs) and websites. Digital or mobile health interventions are often automated, interactive, and personalised. Although they may entail some direct or continuing connection with a practitioner or health care professional, the primary action, intervention process, or behaviour change strategies should be delivered by the digital or mobile health technology itself (NICE, 2020).

Access to face-to-face services that promote behaviour change in important domains is limited, leaving a significant part of the population underserved. Besides, perceived stigma and cost are important barriers that prevent uptake (Gulliver et al., 2010). Some of these issues can be addressed by digital delivery. They lessen the perceived stigma associated with

asking for help and, in self-guided and anonymous interventions, satisfy some users' preferences for independence. Digital resources are frequently cost-free or have modest user charges and can be very cost-effective, especially with self-guided and substantial user numbers (Lintvedt et al., 2013). Additional advantages of DHBCIs compared with face-to-face are, content consistency, the possibility for users to access support whenever and wherever they need it, review content, and receive reminders to engage in behaviours.

Digital tools can also be used to connect with practitioners or peer groups or be used independently between face-to-face sessions. Many individuals can now carry a coach or therapist 'in their pocket' (Cunningham & van Mierlo, 2009; Hagger et al., 2020; Prestwich et al., 2018). However, engagement and sustained usage of self-guided interventions with multiple components remain a critical issue in this kind of tools. Besides, effect sizes of self-guided interventions are often smaller than therapist-coached interventions (Cunningham & van Mierlo, 2009; Hagger et al., 2020).

Digital behaviour change support is becoming more widely accepted and a significant part of mental health care offered globally, reaching many people who have never sought therapy before (Titov et al., 2018). Despite inconsistent evidence regarding DHBCIs there is now relevant evidence that some digital interventions can have significant effects (Hagger et al., 2020; NICE, 2020; Prestwich, et al., 2018).

Addressing unhealthy behaviours related to alcohol consumption can lower the chance of developing chronic diseases as well as enhance social, emotional, and mental health. Additionally, it can assist people in self-managing or self-monitoring their alcohol use or mental health issues with the goal of lowering alcohol intake. It is therefore important to identify which elements and characteristics of digital and mobile health interventions are most effective at changing drinking behaviours (NICE, 2020). Systematic reviews of DHBCIs have revealed that they can be more successful than controls at reducing hazardous and harmful alcohol use (Black et al., 2016; Kaner et al., 2017; Beyer et al., 2022).

Black et al. (2016) explored in a meta-analysis and meta-regression, which study characteristics, theories and BCTs are associated with computer-delivered interventions' (CDI) effectiveness to reduce alcohol intake. It included randomised studies that compared self-directed CDIs to assessment only control groups (93 CDIs). BCTs were coded according with the taxonomy targeting alcohol consumption (Michie et al., 2012). The most common employed techniques were, provide feedback on performance. The average effect of CDIs on

alcohol consumption was small but significant. The HED frequency had the least effect (d+ = 0.07), whereas the total consumption had the biggest effect (d+ = 0.15). In the short term, the effects produced by CDIs were small-to-medium on all outcomes (d+ = 0.16–0.31), except drinking frequency (d+ = 0.06). In the medium-to-long term, CDIs had small significant effects on all outcomes (d+ = 0.07–0.12). Greater impacts in total consumption and peak consumption were verified with the social norms approach, whenever normative information was provided, feedback about the performance was given and in interventions that involved some human contact (Black et al., 2016).

Kaner et al. (2017) meta-analysis aimed to determine whether personalised heavy drinking reduction guidance, delivered by computer or mobile device, is superior to no intervention, printed information and brief face-to-face interventions. It also studied the effectiveness of BCTs (Michie et al., 2013), their mechanisms of action, and the theories or models that were applied during the intervention's development and/or evaluation (Michie & Prestwich, 2010). Based on the analysis of 41 trials the authors concluded that there is fair-quality evidence that suggests digital interventions may reduce the quantity of alcohol consumed per week. Participants who received a digital intervention drank approximately 23 g alcohol per week (95% CI 15 to 30) less than control group at end of follow up. The review was inconclusive regarding the comparison of digital and face-to-face interventions. The efficacy of digital interventions to reduce alcohol consumption was linked to the BCTs 'behaviour substitution' (B -95.12, 95% CI -162.90 to -27.34), 'problem solving' (B -45.92, 95% CI -90.97 to -0.87) and 'credible source' (B -32.09, 95% CI -60.64 to -3.55). The reporting of theory use was very scarce and, when it was reported, frequently vague (Kaner et al., 2017).

The three BCTs identified above were validated in a study by Garnett et al. (2018[a]), which included forty-one randomised control trials and also identified the BCTs 'behaviour substitution' (−95.112 grams per week [gpw], 95% CI: −162.90, −27.34), 'problem solving' (−45.92 gpw, 95% CI: −90.97, −0.87) and 'credible source' (−32.09 gpw, 95% CI: −60.64, −3.55). Garnett et al. (2018[b]) also investigated the role of theory in the development and evaluation of digital interventions to reduce hazardous and harmful alcohol consumption and whether its reporting was associated with intervention effectiveness. Through the analysis of 41 studies (n = 42 arms), the authors concluded that there was significant variation in the effects of treatments on alcohol reduction across trials (I^2 = 77.6%, P<.001). No significant

correlation was found in unadjusted models between reporting theory use and interventions' success.

Building on previous investigations, the most recent systematic review and meta-analysis by Beyer et al. (2022) compared the efficacy of interventions administered by practitioners to those delivered online ($n = 201$ trials, 199 papers). Practitioner-delivered interventions for reducing hazardous and harmful alcohol consumption were found to be more effective than digital interventions. This mean difference in alcohol consumption in grams per week was verified at 1 and 6 months, but not at 12 months (1 month: −23 g/wk [95% CI, −43 to −2]; 6 months: −14 g/wk [95% CI, −25 to −3]; 12 months −6 g/wk [95% CI, −24 to 12]).

According to NICE (2020), there is limited evidence that mobile and digital health treatments can help consumers reduce their alcohol consumption. Due to effectiveness heterogeneity and the limited population covered in the evidence reviewed (16 studies) it is unclear which interventions are more effective. For example, two intervention studies targeting college students, based on a single session, and including the same BCTs (feedback and monitoring, goals and planning, comparison of outcomes and shaping knowledge), showed different outcomes in terms of effectiveness. In Hester et al. (2012) study, which evaluated effectiveness of the College Drinker's Check-up (CDCU) in reducing heavy drinking and alcohol- related problems, there were significant differences in outcomes between intervention and control. On the contrary, in Carey et al. (2017) study, the participants in the intervention arm which completed a screening on the CDCU, and received personalised feedback on their drinking habits, showed a similar effectiveness to control.

However, the committee acknowledged that some interventions might be effective and for some individuals, recommending therefore the use of DHBCIs to reduce alcohol intake in addition to other individual behaviour modification services. The committee produced a weak recommendation considering the interventions could be effective for particular demographics and contexts, namely young people and underserved groups (aged 18-25). A high proportion of studies used personalised normative feedback (PNF) (i.e., comparing what is known about the recipient with what is known about others), and interventions with PNF showed a higher effectiveness compared with those that did not include that component. There was enough data to suggest that interventions with multiple interactions were more effective than one-off interventions. Despite that fact, it was recommended that one-off interventions should not be excluded as they showed some effectiveness (NICE, 2020).

NICE (2020) guidelines cover DHBCIs to promote behaviour change towards a healthier lifestyle. When designing these interventions, it is recommended to employ approaches for behaviour change that are supported by evidence and that assist individuals in initiating and sustaining change (i.e., goals and planning, feedback and monitoring, and social support). It is also suggested that the interventions enable the user to tailor goals to their needs.

Tailoring as a strategy to enhance ehealth/digital interventions

There are several factors that influence the success of DHBCIs. This includes the intervention's content, the underlying theory as well as how it is tailored to individuals (Prestwich et al., 2018). Evidence regarding digital and mobile health interventions to reduce alcohol consumption suggests that 'one size does not fit all' (NICE, 2020).

In Kreuter et al. original definition, tailoring was defined as 'any combination of strategies and information intended to reach one specific person, based on characteristics that are unique to that person, related to the outcome of interest and derived from an individual assessment' (1999, p. 277). Compared to generic, non-personalised health messages, tailored ones command more attention and are more likely to be read, elaborated on, recalled, and comprehended (Lustria et al, 2009; Ryan et al., 2019).

The process of tailoring involves individualising the information, counsel, and assistance given to each user (Harrington & Noar, 2012). The level of tailoring for a particular person can really be seen as a continuum, ranging from the most general information to the most precisely tailored information (Kreuter et al., 1999). Tailoring is a multi-step and multidimensional process. The first step consists in the assessment of an individual's characteristics, needs and theoretically significant elements connected to the targeted behaviour (e.g., motivations, attitudes, beliefs, risk behaviours). Personalised messages are developed based on the assessment and then conveying through several appropriate strategies and channels. The multi-faced communication aims to increase perceived personal relevance of health messages contributing, subsequently, to the creation of situations that are conducive to persuasion and behaviour change (Lustria et al., 2009, 2016; Noar et al., 2011).

According with NICE (2007) interventions should be tailored to meet participants' needs by: using validated appropriate tools for the population and setting, considering participants physical and psychological ability to make a change, the environment in which

they live and work, they level of motivation as well as specific needs related to a person's sexual orientation, gender, culture, religion, or any kind of disability.

The sophistication of tailoring has been greatly enhanced by digital technology. Automated algorithms can be utilised to modify interventions in a variety of ways based on pre-known variables or data input by specific users. Powerful expert systems now make it feasible to automate the gathering of personal data, which can subsequently be utilised to create personalised health plans and offer individualised feedback. Expert systems that support tailored interventions allow for customising on a variety of behaviourally influencing parameters, approaching a level of personalisation that was previously only possible through in-person contacts with specialists or qualified healthcare professionals. Web delivery makes it easier to deploy customised programs for larger audiences, hence improving accessibility to the advantages of customisation regardless of geographic and temporal constraints. Web-based tailored intervention programs hold great potential for changing patient habits and enhancing health outcomes for a range of illnesses and patient populations (Lustria et al, 2009, 2013; Morrison, 2015).

Persuasive information can be tailored to individual characteristics using digital technology through, personalisation, feedback and content matching. Personalisation refers to the incorporation of one or more recognisable individual features in the content information. Identification, raising expectation and contextualisation are the most common personalisation tactics. Identification is expected to enhance exposure likelihood or attention devoted to information; Raising the bar for customisation entails making overt assertions of it, like 'the following health information has been uniquely designed for you'; Framing one's communication in a context that is significant to the audience is a third tailoring technique for boosting attention, interest, and motivation to process information. Contextualised messages may be viewed as more relevant to the individual and the tailoring agent as more believable and familiar. The second tailoring technique, feedback, involves letting the person know something about him or herself that is relevant to significant personal objectives. Feedback can be descriptive, comparative, or evaluative. Descriptive feedback consists of reporting back to individuals a summary of their beliefs, attitudes or behaviours from observational data or personal assessments. In comparative feedback, a person beliefs, attitudes or behaviours is compared to those of others. In evaluative feedback a level of interpretation, inference and/or judgement is added. Finally, content matching, often thought as the essence of tailoring,

addresses key theoretical determinants of the behaviour of interest (knowledge, normative beliefs, outcome expectations, skills and/or efficacy) (Dijkstra, 2008; Hawkins et al., 2008).

Table A2

Tailoring strategies and tactics

Tailoring Strategies	Definition	Tailoring Tactics
Personalisation	Incorporating recognisable aspects of a person in the content information. Helps to increase the message's perceived meaning by giving the idea that it was created especially for the recipient.	Identification - Identifies recipient by name or other unique identifiers Raising expectation - Makes overt claims of customisation Contextualisation - Presents information in a meaningful context
Feedback	Individual recommendations based on an expert assessment of the persons' needs or characteristics related to the targeted behaviours. Feedback focuses the individual's attention on their own traits or behaviours.	Descriptive - Reports what is known about the recipient based on his or her data Normative or comparative - comparing what is known about the recipient with what is known about others Evaluative and motivational – Makes interpretations or judgments based on what is known about the recipient
Adaptation or content matching	Requires examining each person's key determinants of the behaviour of interest (knowledge, normative beliefs, outcome expectations, skills and/or efficacy), identifying the messages that would be most successful for them, and then tailor the right material to each one.	

Note. Adapted from Dijkstra (2008) and Hawkins et al. (2008)

Even though tailoring ingredients are presented as separate strategies, they are frequently utilised in conjunction with one another and with different methods from the same category. The choice of certain strategies and tactics should be deliberate, informed by theory and/or empirical research, and take in consideration the benefits and disadvantages of each strategy (Hawkins et al., 2008).

According to Morrison (2015), the potential contribution of psychological theory to inform optimal intervention design has received little attention. His review provides several theory-based recommendations for optimising users' overall experiences of engaging with

digital health behaviour change intervention. For example, the implementation of any design feature or BCT needs to support users' sense of autonomy by offering choice and flexibility in how they use the intervention or engage with the behaviour change process. This may be achieving a balance between tailoring intervention content to relevant theoretical variables whilst still allowing users to choose the information and support they feel they need and/or want (e.g., 'self-tailoring'). Before attempting to persuade or impart new knowledge, tailored material should: (a) identify potential counterarguments; (b) incorporate unambiguous self-referential hints or personally pertinent data (such as the user's name).

Several systematic reviews and meta-analyses have found that tailoring can be an effective strategy for changing health behaviour across a wide variety of health outcomes, pointing to small and moderate effects (Krebs et al., 2010; Lustria et al., 2009, 2013; Noar et al., 2007; Ryan et al., 2019). The 'first generation' of tailoring studies analysed tailored printed health behaviour change interventions. Noar et al. (2007) meta-analysed 57 print tailoring studies investigating whether tailored print messages have influenced changes in health behaviour. The authors examined a number of sets of moderators that may impact the effect of tailoring, including, participants' features, type of behaviour, intervention, methodological characteristics and theoretical concepts. Tailored messages performed better than other types (e.g., generic/targeted) of messages and even outperformed no-treatment controls. Smoking cessation trials had significant effects that were greater than other tailoring applications, such as mammography screening and physical activity. The findings showed that interventions involving several contacts had much bigger effect sizes than those involving a single point of contact. Individuals participating in studies with a single point of contact frequently receive normative feedback or tailored messages based on a comparison of their responses to those of their peers. However, studies with many contacts offer the chance to provide participants with what is known as ipsative feedback, or messages based on a comparison of their present responses with their responses at the previous intervention time point. Almost all studies where tailoring was based on theoretical concepts tended to have bigger impact sizes.

Lustria et al. (2009) conducted a systematic review to investigate how computer-tailored, online behavioural interventions have been operationalised in various contexts, and what criteria and mechanisms are employed to customise health messages. The authors concluded that the features and formats used in tailored self-directed health interventions delivered via the web have been extremely diverse. The interventions in the 30 studies ranged

in sophistication from quick risk/health assessments, tailored web content, to fully developed, personalised health programs. Health behaviours and stages of change were the most common variables for tailoring content. A combination of feedback, personalisation and adaptation was used to tailor messages.

Lustria et al. (2009) review included three tailored digital interventions addressing alcohol consumption, two of them targeting college students (Chiauzzi et al., 2005; Kypri et al., 2004) and one adult employees with low to moderate risk for alcohol problems (Matano et al., 2007). The three alcohol abuse prevention studies evaluated the participants' risk factors and health-related activities. Assessments of current alcohol use, risk for alcoholism and alcohol-related issues, together with alcohol-related beliefs and behaviours were used to tailor treatment. In two of the interventions, the material was tailored using standardised screening techniques.

Chiauzzi et al. (2005) intervention consisted of a brief tailored web-intervention designed to provide motivational feedback to college students with a high risk for binge drinking ($n = 131$ intervention group; $n = 134$ control group). Based on the actions and risk perceptions, immediate, customised feedback was made available for printing. Then, students had access to a health website that had customised information illustrating individual risk factors and numerous skill-building opportunities. The customised web intervention considerably reduced alcohol intake, particularly among female students both on special occasions (F $(1, 171) = 4.28$, p $= .04$, η2 $= .025$) and chronic binge drinkers (F $(1, 171) = 3.62$, p $= .059$, partial η2 $= .021$).

Kypri el al. (2004) evaluated the effectiveness of a quick, tailored intervention meant to discourage risky drinking among college students (intervention, $n = 51$ and control group, $n = 53$). A 14-day retrospective drinking diary, self-reported weight, and perceptions of peer drinking norms were used to tailor the intervention. Participants then got normative feedback comparing their consumption with national and university norms, as well as comments on their risk. Participants in the intervention group reported much less overall drinking (0.56-0.96 - geometric mean ratio = 0.74; 95% confidence interval), less frequent heavy episodes (0.63; 0,42-0.92), and fewer personal problems (0.70; 0.54-0.91). Normative feedback (i.e., contrasting one's own behaviours with those of peers) is considered an effective tactic in computer-tailored brief interventions for risky drinking among college students. Even though they are brief, this preliminary data suggests that short-term, customised behavioural interventions for preventing alcoholism in young people are effective.

Krebs et al. (2010) evaluated in a series of meta-analysis, the impact of 88 computer-tailored interventions that targeted smoking cessation (k = 32), increased physical activity (k = 25), improved diet (k = 25), and mammography screening (k = 12). Considering the average of the four health behaviours, a significant, small effect was found (g = 0.17). In terms of smoking cessation, at final follow-up, the average point prevalence abstinence was 20% compared to 14% in the control group. For physical activity, at follow-up, 43% of participants who received computer-tailored messages adhered to physical activity recommendations, compared to 34% of participants in the control groups. Computer-tailored treatments led to 56% adherence for mammography screenings compared to 50% in comparison groups while the absolute rate of fruit and vegetable intake was estimated to increase from 27% to 37%. In terms of effect size moderators, dynamically tailored interventions (evaluating the intervention parameters before each feedback) were found to have increased efficacy over time as compared with tailored static (based on a single assessment) interventions.

Lustria et al. (2013) investigated the efficacy of tailored web-based interventions on health behaviour outcomes and explored moderators of intervention efficacy. The meta-analysis included forty experimental and quasi-experimental studies targeting physical activity, medication adherence, smoking/tobacco use, drinking, nutrition, stress management and faecal soiling. Moderators tested included participants (e.g., gender, age, population type, behaviour studied) intervention/tailoring (frequency of tailoring assessment and user control) and methodological characteristics (study design, type of comparison condition, study retention and length of follow-up). The results showed that web-based tailored interventions significantly improved health outcomes compared to control circumstances both at post-testing (d=.139 (95% CI=.111, .166, p<.001, k = 40) and follow-up, d=.158 (95% CI = .124, .192, p < .001, k = 21).

There was a lot of variation in the methods used for tailoring among the articles they featured, including variations in intervention features, formats, and levels of interactivity (Lustria et al., 2013). Providing feedback on the behaviour is typically the minimal amount of tailoring that has been conducted in this literature (Noar et al., 2007). The multimodal, interactive nature of web-based tailored interventions makes it challenging to tease out moderators of efficacy. As a result, a variety of factors can have an impact on efficacy, including the delivery methods, study characteristics, participant population, number of intervention contacts, and the use of theory-based assessment (Lustria et al., 2009).

While reviewing tailoring literature, Harrington and Noar (2012) noticed reporting information inconsistency related to intervention development, implementation and evaluation. The authors stressed the importance of standardising reporting not only to improve reader comprehension but also to facilitate replication and synthesis. They provided several recommendations for reporting studies of tailored interventions, including the description: of the theoretical variables used on intervention message design, how the theory informed intervention message design, what type of tailored messages participants receive, the tailoring system algorithms, the tailoring intervention channel, format, dosage, and context and when the intervention is delivered and assessment schedule.

The above-mentioned studies support the use of tailoring as a strategy in interventions aimed at changing health behaviour. Although research into the underlying mechanics of tailoring has started, we still don't fully understand how it operates or why it is more effective than non-tailored alternatives (Lustria et al., 2016). Prior research on tailored health interventions has mostly concentrated on determining whether tailoring is effective as opposed to studying how it works or which approaches are most beneficial and under which situations. Previous tailoring research has struggled to distinguish between the various tailoring methodologies, modality distinctions, intervention aspects, and component types (Dijkstra, 2008; Hawkins et al., 2008; Lustria et al., 2013). Several questions remain without answer, namely, which factors affect the success of a behavioural intervention? What aspects of the intervention were specifically tailored (e.g., content, mode of delivery, intensity/duration) and on what basis (e.g., participant characteristics, environment, etc.)? Was the underlying theory (if any) used to tailor the intervention? And if so, how was the theory applied to tailoring? (Prestwich et al., 2018).

It is crucial that tailoring researchers continue to investigate under what situations and conditions web-based tailored health behaviour change interventions can be most effective (Krebs et al., 2010; Lustria et al., 2013; Noar et al., 2011). There is therefore the need to explore the components of DHBCIs to reduce alcohol intake to inform how interventions work and who might benefit most in which contexts.

Appendix B – Additional tables

Table B1

Study characteristics

#	Authors[a]	Year[a]	Country[a]	Study Design	Mean age sample[a]	% Females	Recruitment Setting[a]	Type of control[a]	Type of Intervention[a]	Intervention name[a]	Follow-up/ month[a]	Sample
1	Acosta et al.	2017	USA	RCT	34	7%	Primary Care	Ass	Digital	Thinking Forward	1, 3	N=162; CG=81; IG=81
2	Araki et al.	2006	Japan	3 arm RCT	44	0%	Workplace	Ass	Both		2	N=36; CG=12; IG=12
3	Bendtsen et al.	2015	Sweden	Parallel RCT	N/A	49%	University	Ass	Digital	Amadeus-2	2	N=1605; CG=780; IG=825
4a	Berman et al.	2019	Sweden	3 arm RCT	26	68%	University (via email +FB)	Ass	Digital	Promillekol/ PartyPlanner	7 wks	N=2166; CG=722; IG=722-Pr IG=722-Pl
4b	Berman et al.	2019	Sweden	Parallel RCT	25	69%	University	Ass	Digital	Telecoach	6, 12 wks	N=330; CG=144; IG=93 WL=93
5	Bertholet et al.	2015	Switzerland	Parallel RCT	25	0%	Army (email)	Ass	Digital	Based on Alcooquiz	1, 6	N=737; CG=370; IG=347
6	Bertholet et al.	2019	USA	Parallel RCT	34	46%	Mechanical Turk (online)	Ass	Digital		6	N=977; CG=516; IG=461
7	Bischof et al.	2008	Germany	3 arm RCT	36	32%	Primary Care	Att Booklet on health behavior	Combined/ stepped		12	N=408; CG=139; IG=138-Sc IG=131-Fc
8	Blankers et al.	2011	Netherlands	3 arm RCT	42	51%	Community	Ass	Digital + Integrated	Jellinek	3, 6	N=205; CG=69; IG=68-Tao IG=68-Sao
9	Boon et al.	2011	Netherlands	RCT	40	0%	Community	Alc Brochure on alcohol	Digital	Drinktest	1, 6	N=450; CG=220; IG=230
10	Boβ et al.	2018	Germany	3 arm RCT	47	59%	Workplace	Alc	Digital	GET.ON	6 wks 6 mths	N=434; CG=144; IG=230-Ug IG=144-Gd
11	Brendryen et al.	2017	Norway	RCT	43	52%	Workplace	Alc e-book about alcohol	Digital	Balance	2, 6	N=85; CG=42; IG=43

#	Authors[a]	Year[a]	Country[a]	Study Design	Mean age sample[a]	% Females	Recruitment Setting[a]	Type of control[a]	Type of Intervention[a]	Intervention name[a]	Follow-up/month[a]	Sample
12	Brendryen et al.	2014	USA	RCT	37	33%	Community	Alc Brief self help (PNF+e-booklet)	Digital	Balance	2, 6	N=244; CG=119; IG=125
13	Brief et al.	2003	USA	RCT	32	13%	Facebook	Ass	Digital	VetChance	2	N=600; CG=404; IG=196
14	Butler et al.	2003	USA		41	NA	Primary care	Ass	Digital	HHS (Health Habits Survey)	6	N=151; CG=66; IG=62
15	Butler & Correia	2009	USA	3 arm RCT	20	65%	University	Ass	Both	MI	1	N=84; CG=26; IG=30-Cp
16	Cadigan et al.	2017	USA	RCT	21	71%	University	Alc Text message alcohol effects	Digital	TXT PFI	1	N=133; CG=66; IG=62
17	Carey et al.	2017	USA	RCT	21	61%	University	Ass	Digital	CDCU	1, 3, 6	N=381; CG=191; IG=190
18	Chiauzzi et al.	2005	USA	RCT	20	54%	University	Alc Online info + reading articles about high risk drinking	Digital	My Student Body: alcohol	3	N=265; CG=134; IG=131
19	Collins et al.	2014	USA	3 arm RCT	21	56%	University	Ass	Digital	PNF	1, 6, 12	N=724; CG=231; IG=251-DBF IG=242- PNF
20	Crombie et al.	2018	Scotland	Parallel RCT	35	0%	Community	Att Text messages on general health	Digital	TRAM	3, 12	N=825; CG=414; IG=411
21	Cucciary et al.	2013	USA	RCT	58	12%	Primary Care	Alc ~20m brief F2F education alcohol effects and advice	Combined	FRAMES	3, 6	N=78; CG=78; IG=89
22	Cunningham et al.	2015 a	Canada	3 arm RCT	19	48%	Emergency Care	Ass	Both	U-Connect	3, 6, 12	N=836; CG=281; IG=277-BI
23	Cunningham et al.	2015 b	Canada	4 arm RCT	30	61%	Online	Alc	Both	CYDU	3	N=741; CG=187; IG=183 – NF; IG=186 – PF; IG=185 - CYD

#	Authors[a]	Year[a]	Country[a]	Study Design	Mean age sample[a]	% Females	Recruitment Setting[a]	Type of control[a]	Type of Intervention[a]	Intervention name[a]	Follow-up/ month[a]	Sample
24	Cunningham et al.	2009	Canada	RCT	40	47%	Community	Alc Asked revised self-help drinking materials	Digital	Check Your Drinking (CYD)	3, 6	N=185; CG=93; IG=92
25	Cunningham et al.	2012	Canada	RCT	23	48%	Email	Ass	Digital	CYD – Uni version	6 wks	N=425; CG=214; IG=211
26	Cunningham et al.	2017	Canada/USA	RCT	35	43%	Online	Ass	Digital	CYD	3	N=423; CG=209; IG=214
27	Delrahim-Howlett et al.	2011	USA	RCT	26	100%	Primary care	Alc Alcohol risks in general and pregnancy	Digital	Adapted eCHUG	1, 2	N=150; CG=75; IG=75
28	Deluca et al.	2020	UK	RCT	16	51%	Emergency Care	Ass	Both	SIPS	6, 12	N=756; CG=241; IG=252 eBI
29	Doumas et al.	2010	USA	RCT	18	57%	University	Alc Website alcohol consumption and guidelines	Digital	eCHUG	3	N=113; CG=51; IG=62
30	Doumas et al.	2011	USA	RCT	18	65%	University	Ass	Digital	eCHUG	3	N=350; CG=183; IG=167
31	Duroy et al.	2016	France	Parallel RCT	41	21%	Emergency Care	Att Nutrition education program	Digital	BREVALCO	6, 12	N=572; CG=286; IG=286
32	Ekman et al.	2011	Sweden	RCT	N/A	57%	University	Alc Brief feedback	Digital	eSBI	3, 6	N=158; CG=78; IG=80
34	Gajecki et al.	2014	Sweden	3 arm RCT	25	52%	University	Ass	Digital	Promillekol/ PartyPlanner	7 wks	N=1932; CG=649; IG=643 Pr IG=640 Pa
35	Geisner et al.	2015	USA	4 arm RCT	20	62%	University	Alc Info depression and substance abuse	Digital		1	N=1932; CG=85; IG=84 AO IG=85 I
36	Gilmore et al.	2015	USA	5 arm RCT	19	100%	University	No, Ass	Digital	PNF	3	N=264; CG=54; Full Ass CG=53; Min Ass IG=53 Alcohol only

#	Authors[a]	Year[a]	Country[a]	Study Design	Mean age sample[a]	% Females	Recruitment Setting[a]	Type of control[a]	Type of Intervention[a]	Intervention name[a]	Follow-up/ month[a]	Sample
37	Guillemont et al.	2017	France	Parallel RCT	N/A	32%	Email	Alc Feedback consumption; access to diary	Digital	Alcoometre; PNF	6 wks	IG=52 SARR Only IG=52 Combined N=1147; CG=413; IG=734
38	Hansen et al.	2012	Denmark	3 arm parallel RCT	59	45%	Community	Ass	Digital	PNF	6, 12	N=1380; CG=454; IG=450
39	Hasin et al.	2013	USA	3 arm parallel RCT	46	22%	HIV Clinic	Alc Feedback excessive alcohol; pamphlet drinking reduction	Practitioner + Combined	HealthCall-IVR; MI	3, 6, 12	N=264 CG=88; IG=82 MI IG=88 MI+Health Call
40	Hedman & Akagi	2008	USA	RCT	19	58%	University	Alc Alcohol facts via email	Digital		6 wks	N=131; CG=63; IG=68
41	Hester & Delaney	1997	USA	RCT	36	40%	Community	Ass	Digital	BSCPWIN	10 wks 20 wks 12 mths	N=40; CG=20; IG=20
42	Hester et al.	2005	USA	RCT	36	48%	Community	Ass	Digital	Drinkers CheckUp	1, 2, 12	N=61; CG=26; IG=35
43 a	Hester & Campbell (Study 1)	2012	USA	RCT	46	38%	Community	Ass	Digital	CDCU	1, 12	N=144; CG=79; IG=65
43 b	Hester & Campbell (Study 2)	2012	USA	RCT	20	44%	University	Delayed Ass	Digital	CDCU	1	N=82; CG=40; IG=42
44	Jo et al.	2019	South Korea	Parallel RCT	N/A	48%	Research Panel	Ass	Digital	on-BEAM; PNF	1	N=1496; CG=748; IG=748
45	Khadjesari et al.	2014	UK	RCT	48	25%	Workplace	Att Feedback health behaviours except alcohol	Digital	Down your Drink	3	N=1330; CG=671; IG=659
46	King et al.	2019	USA	RCT	19	61%	University	No ctrl arm	Both	BASICS	1, 2, 3	N=51

#	Authors[a]	Year[a]	Country[a]	Study Design	Mean age sample[a]	% Females	Recruitment Setting[a]	Type of control[a]	Type of Intervention[a]	Intervention name[a]	Follow-up/ month[a]	Sample
47	Kypry et al.	2004	New Zealand	RCT	20	50%	University Health Center	Alc Leaflet alcohol facts and effects	Digital	eSBI	6 wks 6 mths	N=104; CG=53; IG=51
48	Kypry et al.	2008	New Zealand	3 arm RCT	20	52%	University Health Center	Alc Pamphlet health effects alcohol	Digital	eSBI	6, 12	N=576; CG=146; IG=138 Single dose IG=145 Multi dose
49	Kypry et al.	2009	New Zealand	Parallel RCT	20	45%	University	Ass	Digital	THRIVE	1, 6	N=2435; CG=1184; IG=1251
50	Kypry et al.	2013	New Zealand	Parallel RCT	20	66%	University	Ass	Digital	eSBI	5	N=1789; CG=850; IG=939
51	Kypry et al.	2014	New Zealand	Parallel RCT	20	57%	University	Ass	Digital	eSBI	5	N=3422; CG=1716; IG=1706
52	LaBrie et al.	2013	USA	11 arm RCT	20	57%	University	Att Normative feedback not alcohol related	Digital	Web-BASICS	1, 3, 6, 12	N=1831; CG=184; IG=183 Web BASICS; IG=187 (student norms); N=184 (Sex norms); N=185 (Greek norms); N=178 (Race norms); N=185 (Sex, Race norms); N=187 (Sex, Greek norms); N=190 (Race, Greek norms); N=187 (Sex, race, Greek norms)
53	LaLiberte	2018	USA	RCT	N/A	55%	University	Alc Factual info alcohol	Digital	MI	1	N=103; CG=51; IG=49
54	Leeman et al.	2016	USA	4 arm RCT	20	63%	University	Alc Electronic brochure alcohol risks	Digital	US THRIVE	1, 6	N=208; CG=48; IG=48 Direct PBS only

#	Authors[a]	Year[a]	Country[a]	Study Design	Mean age sample[a]	% Females	Recruitment Setting[a]	Type of control[a]	Type of Intervention[a]	Intervention name[a]	Follow-up/ month[a]	Sample
55	Lewis & Neighbors	2007 a	USA	3 arm RCT	20	55%	University	Ass	Digital	PNF (modelled on BASICS)	1	IG=45 Indirect PBS only IG=42 Full PBS N=182; CG=57; IG=65 Gender especific IG=60 Gender neutral
56	Lewis et al.	2007 b	USA	3 arm RCT	19	52%	University	Ass	Digital	PNF	5	N=245; CG=88; IG=70 Gender especific IG=76 Gender neutral
57	Lewis & Patrick	2014	USA	4 arm RCT	20	58%	University	Att Info technology	Digital	PNF	3, 6	N=400; CG=121; IG=119 Alcohol only IG=121 Alcohol-related RSB IG=119 Alcohol+Sex
58	McCarty et al.	2019	USA	RCT	16	70%	School Health Clinic	Alc Care as usual – preventive service questionnaire	Digital	Check Yourself	2	N=3422; CG=1716; IG=1706
59	McPherson	2012	Australia	3 arm RCT	N/A	65%	University	Ass	Both	BASICS; eCHUG	1, 3	N=90; CG=30; IG=30 online eCHUG IG= 30 F2F BASICS
60	Moreira et al.	2012	UK	3 arm RCT	N/A	60%	University	None, Ass	Digital	PNF	6, 12	N=2611; CG=879; IG=872 CG= 860 Delayed
61 a	Murphy et al. (Study 1)	2010	USA	RCT	21	59%	University HC	No Ctrl arm	Both	Alcohol 101	1	N=74; IG=39 BASICS IG=35 Alcohol 101

#	Authors[a]	Year[a]	Country[a]	Study Design	Mean age sample[a]	% Females	Recruitment Setting[a]	Type of control[a]	Type of Intervention[a]	Intervention name[a]	Follow-up/month[a]	Sample
61 b	Murphy et al. (Study 2)	2010	USA	3 arm RCT	19	43%	University	Ass	Both	eCHUG	1	N=133; CG=42 IG=46 BASICS IG=45 eCHUG
62	Nayak et al.	2019	USA	Parallel RCT	N/A	100%	WIC sites	Ass	Digital	DrinkWise	3, 6	N=185; CG=86 IG=99
63	Neighbors et al.	2004	USA	RCT	19	59%	University	Ass	Digital	PNF	3, 6	N=252; CG=126 IG=126
64	Neighbors et al.	2006	USA	RCT	19	56%	University	Ass	Digital	PNF	2	N=214; CG=106 IG=108
65	Neighbors et al.	2010	USA	4 arm RCT	20	58%	University	Att Facts about students at uni	Digital	PNF	6, 12, 18, 24	N=818; CG=164 IG=163 Gender specific PNF basel. IG=164 Gender specific PNF assess. IG=164 Gender non specific FB basel. IG=163 Gender non specific FB assess.
66	Neighbors et al.	2016	USA	3 arm RCT	21	53%	University	Att Facts about students at uni	Digital	PNF	3, 6	N=623; CG=207 IG=207 Gender specific PNF IG=209 Gender specific PSCF
67	Neumann et al.	2006	Germany	Parallel RCT	31	21%	Emergency Care	Ass	Digital		6, 12	N=1139; CG=576 IG=563
68	Palfai et al.	2011	USA	RCT	19	70%	University	Att Info health guidelines	Digital		1	N=119; No information

#	Authors[a]	Year[a]	Country[a]	Study Design	Mean age sample[a]	% Females	Recruitment Setting[a]	Type of control[a]	Type of Intervention[a]	Intervention name[a]	Follow-up/ month[a]	Sample
69	Pedersen et al.	2017	USA	RCT	29	17%	Facebook	Att Video game behaviour (self & peers)	Digital	PNF	1	N=793; CG=400 IG=393
70	Postel et al.	2010	Netherlands	RCT	45	54%	Community	Alc Emails alcohol info	Digital	Alcoholdeba as	3	N=156; CG=78 IG=78
71	Ridout & Campbell	2014	Australia	RCT	19	78%	University	Ass	Digital		1, 3	N=95; CG=48 IG=47
72	Rocha	2012	USA	3 arm RCT	25	52%	Facebook or Google Ad	Alc Educational material drinking	Digital	PNF	1	N=276; CG=89 IG=89 PNF IG=98 PNF+PDF
73	Rose et al.	2017	USA	Parallel RCT	N/A	52%	Primary Care	Ass	Digital	IVR-BI	3, 6	N=1855 CG=917 IG=938
74	Schulz et al.	2013	Germany	RCT	42	44%	Email	Ass	Digital	Alcohol - Everything (Within the Limits)	6	N=448 CG=135 IG=132 Alternating condition IG=181 Summative condition
75	Sinadinovic et al.	2014	Sweden	3 arm RCT	44	55%	Online	Ass	Digital	eScreen; Alkoholhjalp en	3, 6 ,12	N=633 CG=210 IG=211 eScreen IG=212 Alkoholhjalpen
76	Spijkerman et al.	2010	Netherlands	3 arm RCT	18	61%	Email	Ass	Digital		1, 3	N=575 CG=190 IG=192 Without Normative FB IG=193 With Normative FB
77	Suffoletto et al.	2014	USA	3 arm RCT	22	43%	Emergency care	Ass	Digital	TRAC	3, 6, 9	N=765 CG=185

#	Authorsa	Yeara	Countrya	Study Design	Mean age samplea	% Females	Recruitment Settinga	Type of controla	Type of Interventiona	Intervention namea	Follow-up/ montha	Sample
												IG=383 SAbf IG=196 SA
79	Thomas et al.	2018	Sweden	RCT	26	57%	University Health Centre	Alc F2F motivational advice, website alcohol consumption estimation and feedback	Digital	Modelled on AMADEUS	3	N=896 CG=436 IG=460
80	Voogt et al.	2013 a	Netherlands	Parallel RCT	17	40%	School	Ass	Digital	What Do You Drink (WDYD)	1, 6	N=609 CG=291 IG=318
81	Voogt et al.	2013 b	Netherlands	Parallel RCT	21	40%	University	Ass	Digital	What Do You Drink (WDYD)	1, 6	N=609 CG=456 IG=457
82	Wagener et al.	2012	USA	4 arms RCT	21	45%	University	Ass Multiass	Both	DRAFT-CS	10 wks	N=152 CG=37 Compreh. Ass CG=39 Minimal ass IG=37 In-person PFI IG =39 DrAFT-CS
83	Wallace et al.	2011	UK	RCT	N/A	57%	Primary Care	Alc Website harms excess alcohol	Digital	Down Your Drink	12	N=7934 CG=3963 IG=3972
84	Wallace et al.	2017	Italy	RCT	N/A	38%	Online	No ctrl arm	Practitioner + Integrated	Adap.from Down Your Drink website	3, 12	N=763 IG=347 FA IG=416 F2F BI
85	Walters et al.	2007	USA	RCT	N/A	48%	Email	Ass	Digital	eCHUG	2	N=106 CG=No info IG=No info
86	Walters et al.	2009	USA	4 arm RCT	20	64%	University	Ass	Practitioner + Combined	eCHUG	3, 6	N=279 CG=69

#	Authors[a]	Year[a]	Country[a]	Study Design	Mean age sample[a]	% Females	Recruitment Setting[a]	Type of control[a]	Type of Intervention[a]	Intervention name[a]	Follow-up/ month[a]	Sample
												IG=67 FBO IG=70 MIO IG=73 MIF
87	Walton et al.	2010	USA	3 arm RCT	17	56%	Emergency Department	Alc Brochure community resources	Digital + Combined	SafERteens	3, 6, 12	N=726 CG=235 IG=237 Computer IG=254 Therapist
88	Weaver	2014	USA	4 arm RCT	N/A	49%	University	Ass	Digital	DrAFT-CS	1	N=176 CG=46 IG=4DrAFT-NR CS IG=44 DrAFT-CS+ IG=39 MSO
89	Wray	2019	USA	RCT	28	0%	Smartphone dating apps	Alc Discussing patterns of risk and obstacles to safer behavior	Digital	Game Plan	1, 2, 3	N=40 CG=20 IG=20
90	Wright	2018	Australia	3 arm RCT	N/A	48%	Community	No, Ass	Digital	EMI	3	N=269 CG=90 IG=90 EMI IG=89 EMA
92	Zill et al.	2019	Germany	Parallel RCT	41	53%	Community	Ass	Digital	Vorvida	3, 6	N=608 CG=302 IG=306

Note. **RCT** (Randomised controlled trial); **N/A** (Not available); **CG** (Control Group); **IG** (Intervention Group)**; Type of intervention**: **Both** (separate arms for practitioner and digitally delivered interventions); **Combined** (person and a device both being used to deliver the same intervention (e.g., a person delivering an intervention supported by feedback on a device); **Integrated** (input to a digital intervention from a person (e.g. messages that appears within the digital intervention)

Type of Control: Ass = Assessment only (participant received a baseline assessment in which they reported their alcohol consumption (amongst other characteristics) and then received no further input; **Att** = Attention control (the group was provided with material or tasks unrelated to alcohol consumption); **Alc** = Minimal alcohol information (minimal intervention arms arise in trials due to ethical concerns around screening someone as a hazardous drinker and then not intervening. They usually provided verbal advice about cutting down, written information about the risks of alcohol consumption, or a list of contact details of organisations that could help with alcohol problems).

[a] Information drawn from Beyer et al. (2022)

Table B2

Tailoring mechanisms and tactics

#	Authors	Intervention	Personalisation			Feedback			Adaptation / Content	Total
			ID	RE	CO	DE	N&C	E&M	matching	per study
1	Acosta et al., 2017					X				1
2	Araki et al., 2006		X							1
3	Bendtsen et al., 2015					X	X	X		3
4a.1	Berman et al., 2019	Promillekoll app						X		1
4a.2	Berman et al., 2019	PartyPlanner app						X	X	2
4b	Berman et al., 2019	TeleCoach app				X		X		2
5	Bertholet et al., 2015					X	X	X	X	4
6	Bertholet et al., 2019					X	X	X	X	4
7	Bischof et al., 2008					X				1
8	Blankers et al., 2011					X		X		2
9	Boon et al., 2011						X	X	X	3
10.1	Boβ et al., 2018						X		X	2
11	Brendryen et al., 2017						X		X	2
12	Brendryen et al., 2014						X		X	2
13	Brief et al., 2003					X	X	X	X	4
14	Butler et al., 2003				X	X			X	3
15	Butler & Correia, 2009					X	X			2
16	Cadigan et al., 2017				X	X	X		X	4
17	Carey et al., 2017					X	X	X	X	4
18	Chiauzzi et al., 2005						X	X		2
19.1	Collins et al., 2013	PNF					X			1
19.2	Collins et al., 2013	DBF				X		X		2
20	Crombie et al., 2015a			X		X				2[a]
21	Cucciary et al., 2013						X	X	X	3

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#	Authors	Intervention	Personalisation			Feedback			Adaptation / Content	Total
			ID	RE	CO	DE	N&C	E&M	matching	per study
22	Cunningham et al., 2015a					X	X	X		3
23.1	Cunningham et al., 2015b	PF+NF				X	X	X		3
23.2	Cunningham et al., 2015b	PF				X		X		2
23.3	Cunningham et al., 2015b	NF					X			1
24	Cunningham et al., 2009					X	X	X		3
25	Cunningham et al., 2012					X	X	X		3
26	Cunningham et al., 2017						X			1
27	Delrahim-Howlett et al., 2011					X	X	X		3
28	Deluca et al., 2020					X			X	2[a]
29	Doumas et al., 2010					X	X	X		3
30	Doumas et al., 2011				X	X	X	X		4
31	Duroy et al., 2016						X	X	X	3
32	Ekman et al., 2011						X	X		2
34.1	Gajecki et al., 2014	PromillKoll				X			X	2
34.2	Gajecki et al., 2014	PartyPlanner				X	X	X	X	4
35	Geisner et al., 2015					X	X	X	X	4
36	Gilmore et al., 2015					X	X	X		3
37	Guillemont et al., 2017					X	X	X	X	4
38.1	Hansen et al., 2012	Personalised feedbak	X				X	X		3
38.2	Hansen et al., 2012	Personalised brief advice	X				X	X		3
39	Hasin et al., 2013					X		X		2
40	Hedman & Akagi, 2008				X	X		X		3
41	Hester & Delaney, 1997						X	X		2
42	Hester et al., 2005		X			X	X	X	X	5

#	Authors	Intervention	Personalisation			Feedback			Adaptation / Content	Total per study
			ID	RE	CO	DE	N&C	E&M	matching	
43a	Hester & Campbell, 2012	CDCU_Exp1				X	X		X	3
43b	Hester & Campbell, 2012	CDCU_Exp2				X	X		X	3
44	Jo et al., 2019					X	X	X	X	4
45	Khadjesari et al., 2014					X		X		2
46	King et al., 2019					X		X		2
47	Kypry et al., 2004					X	X	X		3
48.1	Kypry et al., 2008	Single dose				X	X	X		3
48.2	Kypry et al., 2008	Multi dose				X	X	X		3
49	Kypry et al., 2009						X	X		2
50	Kypry et al., 2013						X	X		2
51	Kypry et al., 2014						X	X		2
52.1	LaBrie et al., 2013	Web-BASICS				X	X	X		3
52.2	LaBrie et al., 2013	PNF Student norms				X	X			2
52.3	LaBrie et al., 2013	PNF Sex norms				X	X			2
52.4	LaBrie et al., 2013	PNF Greek norms				X	X			2
52.5	LaBrie et al., 2013	PNF Race norms				X	X			2
52.6	LaBrie et al., 2013	PNF Sex, Race norms				X	X			2
52.7	LaBrie et al., 2013	PNF Sex, Greek norms				X	X			2
52.8	LaBrie et al., 2013	PNF Race, Greek norms				X	X			2
52.9	LaBrie et al., 2013	PNF Sex, Race, Greek norms				X	X			2
53	LaLiberte, 2018		X				X	X		3

#	Authors	Intervention	Personalisation				Feedback		Adaptation / Content	Total
			ID	RE	CO	DE	N&C	E&M	matching	per study
54	Leeman et al., 2016						X	X		2
55.1	Lewis & Neighbors, 2007a	Gender neutral norms				X	X			2
55.2	Lewis & Neighbors, 2007a	Gender specific norms				X	X			2
56.1	Lewis et al., 2007b	Gender neutral norms					X			1
56.2	Lewis et al., 2007b	Gender specific norms					X			1
57.1	Lewis & Patrick, 2014	Alcohol PNF				X	X			2
57.2	Lewis & Patrick, 2014	Alcohol-related RSB PNF				X	X			2
57.3	Lewis & Patrick, 2014	Combined alcohol + alcohol related RSB PNF				X	X			2
58	McCarty et al., 2019						X	X		2
59	McPherson, 2012				X	X	X	X	X	5
60	Moreira et al., 2012						X	X		2
61a	Murphy et al., 2010					X				1
61b	Murphy et al., 2010					X	X	X		3
62	Nayak et al., 2019					X	X	X	X	4
63	Neighbors et al., 2004						X			1
64	Neighbors et al., 2006						X			1
65.1	Neighbors et al., 2010	SD – Gender nonspecific					X			1
65.2	Neighbors et al., 2010	BA – Gender specific					X			1

#	Authors	Intervention	Personalisation			Feedback			Adaptation / Content matching	Total per study
			ID	RE	CO	DE	N&C	E&M		
65.3	Neighbors et al., 2010	SD – Gender nonspecific					X			1
65.4	Neighbors et al., 2010	BA – Gender nonspecific					X			1
66.1	Neighbors et al., 2016	PNF					X			1
66.2	Neighbors et al., 2016	PSCF					X			1
67	Neumann et al., 2006				X		X	X	X	4
68	Palfai et al., 2011					X	X	X		3
69	Pedersen et al., 2017				X	X	X			3
70	Postel et al., 2010					X		X	X	3
71	Ridout & Campbell, 2014					X	X	X		3
72.1	Rocha, 2012	PSN					X			1
72.2	Rocha, 2012	PNF+PDF				X	X		X	3
73	Rose et al., 2017							X	X	2
74	Schulz et al., 2013				X		X	X	X	4
75.1	Sinadinovic et al., 2014	e-screen.se				X	X	X	X	4
75.2	Sinadinovic et al., 2014	Alkoholhjalpen.se							X	1
76.1	Spijkerman et al., 2010	W/O NF				X		X		2
76.2	Spijkerman et al., 2010	With NF				X	X	X		3
77	Suffoletto et al., 2014							X	X	2
79	Thomas et al., 2018							X		1
80	Voogt et al., 2013a					X	X		X	3
81	Voogt et al., 2013b					X	X		X	3
82	Wagener et al., 2012					X		X		2
83	Wallace et al., 2011					X	X			2
84	Wallace et al., 2017					X	X	X		3
85	Walters et al., 2007					X	X	X		3

#	Authors	Intervention	Personalisation			Feedback			Adaptation / Content	Total per study
			ID	RE	CO	DE	N&C	E&M	matching	
86	Walters et al., 2009					X	X	X		3
87	Walton et al., 2010					X		X	X	3
88	Weaver, 2014					X	X	X		3
89	Wray, 2019					X	X		X	3
90	Wright, 2018				X	X		X	X	3
92	Zill et al., 2019		X			X			X	3
Total per tactic			7	0	10	77	90	68	36	
			(6%)		(9%)	(65%)	(76%)	(58%)	(31%)	

Note. (**ID**) Identification; (**RE**) Raising Expectations; (**CO**) Contextualisation; (**DE**) Descriptive; (**N&C**) Normative or Comparative; (**E&M**) Evaluative and Motivational.

[a] Tailored to the group, not the individual

Table B3

Theory use

#	Authors, year	HAPA	HBM	ICM	SCT	SIT	SLT	SNT	SRT	TM	TPB	Others	Total per Study	Rationale
1	Acosta et al., 2017											CBT	1	No
2	Araki et al., 2006											KAB	1	Yes
4a1	Berman et al., 2019										X		1	Yes
6	Bertholet et al., 2019							X				Risk perception	2	Yes
7	Bischof et al., 2008									X			1	No
8	Blankers et al., 2011											CBT MI	2	No
9	Boon et al., 2011									X			1	No
10	Boβ et al., 2018*	X								X		PST	3	Yes
11	Brendryen et al., 2017								X				1	Yes
12	Brendryen et al., 2014								X	X			2	No
14	Butler et al., 2003									X			1	Yes
17	Carey et al., 2017									X			1	Yes
19.1	Collins et al., 2013						X						1	Yes
19.2	Collins et al., 2013											DMT	1	Yes
20	Crombie et al., 2015a	X											1	Yes
34.1	Gajecki et al., 2014										X		1	Yes
34.2	Gajecki et al., 2014										X		1	Yes
35	Geisner et al., 2015							X					1	No
36	Gilmore et al., 2015							X					1	No
38.1	Hansen et al., 2012								X				1	Yes
38.2	Hansen et al., 2012								X				1	Yes
43a	Hester & Campbell, 2012											MI	1	No

#	Authors, year	HAPA	HBM	ICM	SCT	SIT	SLT	SNT	SRT	TM	TPB	Others	Total per Study	Rationale
43b	Hester & Campbell, 2012											MI	1	No
45	Khadjesari et al., 2014											CBT MI Behaviour self-control Relapse prevention	4	No
52.2	LaBrie et al., 2013					X						SCompT	2	No
52.3	LaBrie et al., 2013					X						SCompT	2	Yes
52.4	LaBrie et al., 2013					X						SCompT	2	Yes
52.5	LaBrie et al., 2013					X						SCompT	2	Yes
52.6	LaBrie et al., 2013					X						SCompT	2	Yes
52.7	LaBrie et al., 2013					X						SCompT	2	Yes
52.8	LaBrie et al., 2013					X						SCompT	2	Yes
52.9	LaBrie et al., 2013					X						SCompT	2	Yes
53	LaLiberte, 2018											MI	1	Yes
55.1	Lewis & Neighbors, 2007a					X		X				SCompT SImpactT	4	Yes
55.2	Lewis & Neighbors, 2007a					X		X				SCompT SImpactT	4	Yes
56.1	Lewis et al., 2007b											SCompT SImpactT	2	Yes
56.2	Lewis et al., 2007b											SCompT SImpactT	2	Yes
57.1	Lewis & Patrick, 2014				X		X	X					3	Yes
57.2	Lewis & Patrick, 2014				X		X	X					3	Yes
57.3	Lewis & Patrick, 2014				X		X	X					3	Yes
59	McPherson, 2012							X				HRT MI	3	Yes

#	Authors, year	HAPA	HBM	ICM	SCT	SIT	SLT	SNT	SRT	TM	TPB	Others	Total per Study	Rationale
60	Moreira et al., 2012							X					1	Yes
61b	Murphy et al., 2010											MI	1	Yes
63	Neighbors et al., 2004							X					1	Yes
64	Neighbors et al., 2006							X					1	Yes
65.1	Neighbors et al., 2010				X	X						Self-categoriza tion theory	3	Yes
65.2	Neighbors et al., 2010				X	X						Self-categoriza tion theory	3	Yes
65.3	Neighbors et al., 2010				X	X						Self-categoriza tion theory	3	Yes
65.4	Neighbors et al., 2010				X	X						Self-categoriza tion theory	3	Yes
66.1	Neighbors et al., 2016							X					1	Yes
66.2	Neighbors et al., 2016							X					1	Yes
69	Pedersen et al., 2017							X					1	Yes
70	Postel et al., 2010											CBT MI	2	No
71	Ridout & Campbell, 2014							X					1	Yes
72.1	Rocha, 2012							X	X				2	Yes
72.2	Rocha, 2012							X	X				2	Yes
74	Schulz et al., 2013			X									1	Yes
75.1	Sinadinovic et al., 2014											MI	1	No

#	Authors, year	HAPA	HBM	ICM	SCT	SIT	SLT	SNT	SRT	TM	TPB	Others	Total per Study	Rationale
75.2	Sinadinovic et al., 2014											CBT MI	2	No
76.1	Spijkerman et al., 2010							X					1	Yes
76.2	Spijkerman et al., 2010							X					1	Yes
77	Suffoletto et al., 2014		X									TRA Inform. Motiv. behaviour model	3	Yes
80	Voogt et al., 2013a			X						X		MI TSI	4	Yes
81	Voogt et al., 2013b			X						X	X	MI TSI	5	Yes
83	Wallace et al., 2011											CBT MI	2	No
85	Walters et al., 2007						X					MI	2	Yes
87	Walton et al., 2010											MI	1	No
89	Wray, 2019											MI	1	Yes
90	Wright, 2018											MI	1	No
92	Zill et al., 2019											CBT	1	Yes
Total		2 (2%)	1 (1%)	2 (2%)	7 (6%)	14 (12%)	5 (4%)	20 (17%)	5 (4%)	7 (6%)	3 (3%)			Yes (77%) No (23%)

Note. Discriminated theories in columns are included in the Behaviour Change Theory Database (https://theory-database.appspot.com/); **(BCT)** Behaviour change theory; **(CBT)** Cognitive-behavioural theory; **(DMT)** Decision-making theory; **(HAPA)** Health Action Process approach; **(HRT)** Harm Reduction Theory; **(HBM)** Health belief model; **(ICM)** I-change model; **(MIT)** Motivational interview; **(PST)** Problem solving theory; **(SCT)** Social cognitive theory; **(SCompT)** Social comparison theory; **(SIT)** Social identity theory; **(SLT)** Social learning theory; **(SNT)** Social norms theory; **(SRT)** Self-regulation theory; **(TM)** Transtheoretical model; **(TPB)** Theory of planned behaviour; **(TRA)** Theory of reasoned action; **(TSI)** Theory of social influence.

Appendix C - Risk of bias within studies

Table C1

Risk of bias assessments for individual included studies

Study	Random	Allocation	Blinding - P	Blinding - O	Incomplete	Selective	Other	Overall
Acosta 2017	Low	Unclear	High	Unclear	High	Low	Low	High
Araki 2006	Unclear	Unclear	High	Unclear	Unclear	Low	Low	Unclear
Bendtsen 2015	Low	Low	High	High	High	Low	High	High
Berman 2019	Low	Low	High	Unclear	Unclear	Unclear	Low	Unclear
Bertholet 2015	Low	Low	Low	Low	Low	Low	Low	Low
Bertholet 2019	Low	Low	Low	Unclear	High	Low	Low	High
Bischof 2008	Low	Low	High	Low	Low	Low	Low	Low
Blankers 2011	Low	Low	High	High	High	Low	Low	High
Boon 2011	Low	High	Unclear	High	Low	Low	Low	High
Bos 2018	Low	Low	High	Unclear	High	High	Low	High
Brendryen 2017	Low	Low	High	Low	High	Low	Low	High
Brendryen 2013	Low	Low	High	Low	High	Low	Low	High
Brief 2013	Unclear	Unclear	High	Unclear	High	Low	High	High
Butler 2003	Unclear	Low	High	High	Unclear	Unclear	High	High
Butler 2009	Unclear	Unclear	High	Unclear	Unclear	Low	Low	Unclear
Cadigan 2019	Low	Unclear	High	Unclear	Low	Low	Low	Unclear
Carey 2017	Low	Low	High	Unclear	High	Low	Low	High
Chiauzzi 2005	Low	Unclear	Low	High	Low	Low	High	High
Collins 2014	Low	Low	High	Low	Unclear	Low	Low	Unclear
Crombie 2018	Low	Low	High	Low	Low	Low	Low	Low
Cucciare 2013	Low	Unclear	High	Low	Low	Low	Low	Unclear
Cunningham 2015 (U-Con)	Low	Low	High	Low	Low	Low	Low	Low
Cunningham 2015 (CYD)	Unclear	Low	High	Unclear	Unclear	Low	Low	Unclear
Cunningham 2009	Low	Unclear	High	Unclear	Low	Low	High	High
Cunningham 2012	Low	Low	High	Low	Unclear	Low	Low	Unclear
Cunningham 2017	Low	Low	High	Unclear	Unclear	Low	Low	Unclear
Delrahim-Howlett 2011	Low	Low	High	Unclear	Low	Low	Low	Low
Deluca 2020	Low	Low	High	Low	High	Low	Low	High
Doumas 2010	Unclear	Unclear	Unclear	Unclear	Low	Low	Low	Unclear
Doumas 2011	Low	Unclear	High	Unclear	High	Low	Low	High
Duroy 2016	Low	Low	Low	Low	High	Low	Low	High
Ekman 2011	Low	Low	Low	Low	High	Low	Low	High
Gajecki 2014	Low	Low	High	Low	High	Low	High	High
Geisner 2015	Low	Low	High	Low	Low	Low	Low	Low
Gilmore 2015	Unclear	Unclear	High	Low	High	Low	High	High
Guillemont 2017	Low	Low	Low	Unclear	High	Low	Low	High
Hansen 2012	Low	Low	High	Low	Unclear	Low	Low	Unclear
Hasin 2013	Low	Low	High	Low	High	High	Low	High

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Study	Random	Allocation	Blinding - P	Blinding - O	Incomplete	Selective	Other	Overall
Hedman 2008	Unclear	Unclear	High	Unclear	High	Low	Low	High
Hester 1997	Unclear	Unclear	High	High	Low	Low	Low	Unclear
Hester 2005	Unclear	Unclear	High	Unclear	Low	Low	Low	Unclear
Hester 2012 (study 1)	Unclear	High	High	Unclear	Low	Low	Low	High
Hester 2012 (study 2)	Unclear	Unclear	High	Unclear	Low	Low	Low	Unclear
Jo 2019	Low	Low	Low	Low	Low	Low	Low	Low
Khadjesari 2014	Low	Low	High	High	Unclear	Low	Low	Unclear
King 2019	Unclear	Unclear	High	Unclear	High	Low	High	High
Kypri 2004	Low	Low	Low	Low	Low	Low	Low	Low
Kypri 2008	Low	Low	High	Unclear	Unclear	Low	Low	Unclear
Kypri 2009	Low	Low	Low	Low	Unclear	Low	Low	Unclear
Kypri 2013	Low	Low	Low	Low	Unclear	Low	Low	Unclear
Kypri 2014	Low	Low	Low	Low	Unclear	Low	Low	Unclear
LaBrie 2013	Low	Low	High	Low	Unclear	Low	High	High
LaLiberte 2018	Unclear	Unclear	High	Unclear	Low	High	Low	High
Leeman 2016	Low	Low	High	Unclear	Unclear	Low	Low	Unclear
Lewis 2007a	Unclear	Unclear	High	Unclear	Unclear	Low	Low	Unclear
Lewis 2007b	Unclear	Unclear	High	Unclear	Low	Low	Low	Unclear
Lewis 2014	Low	Low	High	Low	Low	Low	Low	Low
McCarty 2019	Low	Unclear	High	Unclear	High	Low	High	High
McPherson 2012	Low	Unclear	High	Unclear	High	Low	Low	High
Moreira 2012	Low	Low	High	Low	High	Low	Low	High
Murphy 2010 (study 1)	Low	Unclear	Unclear	Low	Low	Low	Low	Unclear
Murphy 2010 (study 2)	Low	Unclear	High	Low	Low	Low	Low	Unclear
Nayak 2019	Low	Low	High	Unclear	Low	Unclear	Low	Unclear
Neighbors 2004	Unclear	Unclear	High	Unclear	Unclear	Low	Low	Unclear
Neighbors 2006	Unclear	Unclear	High	Unclear	Low	Low	Low	Unclear
Neighbors 2010	Low	Low	High	Low	Low	Low	Low	Low
Neighbors 2016	Low	Low	High	Unclear	Low	Unclear	High	High
Neumann 2006	Unclear	Unclear	High	Unclear	High	Low	Low	High
Palfai 2011	Unclear	Unclear	High	Unclear	Unclear	Low	Low	Unclear
Pedersen 2017	Unclear	Low	High	Unclear	Low	Low	High	High
Postel 2010	Low	Low	High	High	High	Low	Low	High
Ridout 2014	Low	Low	High	Low	Low	Low	Low	Low
Rocha 2012	Low	Low	High	Unclear	High	High	High	High
Rose 2017	Low	Low	High	Low	High	Low	Low	High
Schulz 2013	Low	Low	High	Low	High	Low	Low	High
Sinadinovic 2014	Low	Low	High	Low	High	Low	Low	High
Spijkerman 2010	Low	Low	High	Low	High	Low	Low	High
Suffoletto 2014	Low	Low	High	Low	Unclear	Low	Low	Unclear
Thomas 2018	Low	Low	High	Unclear	Low	Low	High	High
Voogt 2013a	Low	Low	Unclear	Unclear	High	Low	Low	High
Voogt 2013b	Low	Low	Unclear	Unclear	Low	Low	Low	Low
Wagener 2012	Low	Unclear	High	Low	Low	Low	Low	Unclear
Wallace 2017	Low	Low	High	High	Low	Low	Low	Low

Study	Random	Allocation	Blinding - P	Blinding - O	Incomplete	Selective	Other	Overall
Wallace 2011	Low	Low	Low	Low	High	Low	Low	High
Walters 2007	Unclear	Low	High	Unclear	Unclear	Unclear	High	High
Walters 2009	Low	Low	High	Low	Low	Low	Low	Low
Walton 2010	Low	Unclear	High	Low	Low	Low	Low	Unclear
Weaver 2014	Unclear	Unclear	High	Unclear	Unclear	Unclear	Low	Unclear
Wray 2019	Unclear	Unclear	High	High	Unclear	High	High	High
Wright 2018	Unclear	Unclear	Unclear	Unclear	High	Unclear	High	High
Zill 2019	Low	Low	High	Low	High	Low	Low	High

Note. Adapted from Beyer et al. (2022); Random (Random sequence generation); Allocation (Allocation concealment); Blinding (P: Blinding of participants and personnel); Blinding (O: Blinding of outcome) assessment; Incomplete (Incomplete outcome data); Selective (Selective reporting); Other (Other sources of bias); Overall (Overall judgement, where 'High' in any domain except blinding means 'High' overall)

Figure C1

Risk of bias
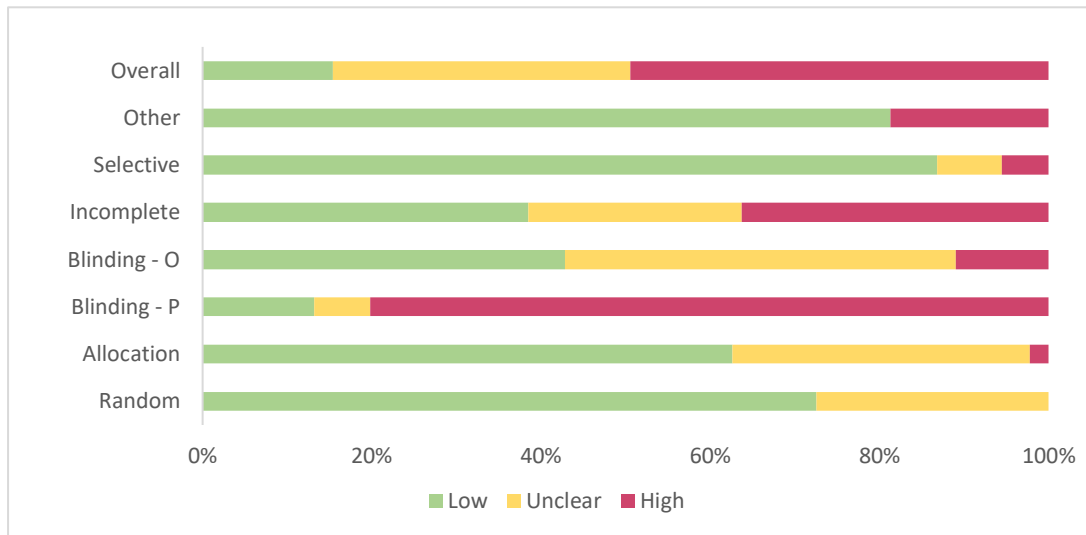
Appendix D - Studies included in the review

Acosta, M. C., Possemato, K., Maisto. S. A., Marsch, L. A., Barrie, K., Latinga, L., Fong, C., Xie, H., Grabinski, M., & Rosenblum, A. (2017). Web-delivered CBT reduces heavy drinking in OEF-OIF veterans in primary care with symptomatic substance use and PTSD. *Behavior Therapy, 48*(2), 262–276. https://doi.org/10.1016/j.beth.2016.09.001

Araki, I., Hashimoto, H., Kono, K., Matsuki, H., & Yano, E. (2006). Controlled trial of worksite health education through face-to-face counseling vs. e-mail on drinking behavior modification. *Journal of Occupational Health, 48*(4), 239–245. https://doi.org/10.1539/joh.48.239

Bendtsen, P., Bendtsen, M., Karlsson, N., White, I. R., & McCambridge, J. (2015). Online alcohol assessment and feedback for hazardous and harmful drinkers: Findings from the AMADEUS-2 randomized controlled trial of routine practice in Swedish universities. *Journal of Medical Internet Research, 17(*7). https://doi.org/10.2196/jmir.4020

Berman, A. H., Gajecki, M., Rosendahl, I., Sinadinovic, K., Andersson, C., & Blankers, M. (2019). Smartphone apps targeting hazardous drinking patterns among university students show differential subgroup effects over 20 weeks: Results from a randomized, controlled trial. *Journal of Clinical Medicine, 8*(11). https://doi.org/10.3390/jcm8111807

Bertholet, N., Cunningham, J. A., Faouzi, M., Gaume, J., Gmel, G., Burnand, B., & Daeppen, J. (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. https://doi.org/10.1111/add.13051

Bertholet, N., Godinho, A., & Cunningham, J. A. (2019). Smartphone application for unhealthy alcohol use: Pilot randomized controlled trial in the general population. *Drug and Alcohol Dependence, 195*, 101–105. https://doi.org/10.1016/j.drugalcdep.2018.12.002

Bischof, G., Grothues, J. M., Reinhardt, S., Meyer, C., John, U., & Rumpf, H.-J. (2008). Evaluation of a telephone-based stepped care intervention for alcohol-related disorders: A randomized controlled trial. *Drug and Alcohol Dependence, 93*(3), 244–251. https://doi.org/10.1016/j.drugalcdep.2007.10.003

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. *Journal of Consulting and Clinical Psychology, 79*(3), 330–341. https://doi.org/10.1037/a0023498

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Appendix E - Studies that could not be retrieved

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Appendix F – Complete data extraction table

Study details						
	Author	Year of publication	Country	Recruitment setting	Assessment follow up	
Sample details						
	Study design	Total sample	Intervention Group(s) sample	Control Group sample	Average age	Gender
Intervention details						
	Type of intervention(s)	Intervention name	Type of control group			
Tailoring elements						
	Individual factors assessed	Dose: Nº of contacts Length of contacts Duration Frequency	Static or dynamic	Informational Mode of delivery: Sub-level 1, 2 and 3	Tailoring mechanisms & tactics	Theory use	How theory informed tailoring
Statistical information						
	Effect sizes provided by authors	Intervention effect				

Appendix G – Abbreviations

BCT: Behaviour change theory

BCTs: Behaviour Change Techniques

BCTT: Behavior Change Tecniques Taxonomy

CBT: Cognitive-behavioural theory

CDI: Computer-delivered Interventions

DALY: Disability-adjusted life years

DHBCI: Digital Health Behaviour Change Interventions

DMT: Decision-making theory

eBAC: Estimated blood alcohol concentration

HAPA: Health Action Process approach

HBM: Health belief model

HBCP: Human Behaviour Change Project

HED: Heavy episodic drinking

HRT: Harm Reduction Theory

ICM: I-change model

MIT: Motivational interview

MoD: Mode of Delivery

PST: Problem solving theory

RCT: Randomised controlled trial

SCT: Social cognitive theory

SCompT: Social comparison theory

SIT: Social identity theory

SLT: Social learning theory

SNT: Social norms theory

SRT: Self-regulation theory

TM: Transtheoretical model

TPB: Theory of planned behaviour

TRA: Theory of reasoned action

TSI: Theory of social influence