Development and Testing of InDEx: A smartphone app and personalised text messaging framework to monitor and reduce alcohol use in ex-serving personnel

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Abbreviation

Term	Abbreviation
Applications	apps
Armed Forces	AF
Alcohol Use Disorders Identification Test	AUDIT
Behaviour Change Technique	BCT
Diagnostic and Statistical Manual of Mental Disorders	DSM
Generalised Anxiety Disorder	GAD
Health Action Process Approach	HAPA
Information about Drinking for Ex-serving	InDEx
King's Centre for Military Health Research	KCMHR
Patient Health Questionnaire	PHQ
United Kingdom	UK

Abstract

Background: Self-reported alcohol misuse remains high among Armed Forces personnel even after they have left service. More than fifty percent of ex-serving personnel meet the criteria for hazardous alcohol use, however many fail to acknowledge that they have a problem. Previous research indicates that interventions delivered via smartphone applications (apps) are suitable in promoting self-monitoring of alcohol use, have a broad reach and may be more cost-effective than other types of brief interventions. There is currently no such intervention specifically designed for the United Kingdom (UK) Armed Forces; a digital format may be most appropriate for personnel leaving the Services given that they will be re-establishing a civilian life and social connections.

Objective: This study involved the development of a tailored smartphone app (including personalised text messaging) and a feasibility study to test the usability of this app in a hard-to-engage ex-serving population.

Methods: App development used Agile methodology (incremental, iterative approach used in software development) and was informed by behaviour change theory, quantitative data on alcohol motivations, participant feedback and focus group data. Participants were recruited from an existing UK longitudinal military health and wellbeing study cohort, pre-screened for eligibility and, directed to download either Android or iOS versions of InDEx. Through the app, participants were asked to regularly log alcohol consumption, complete a range of self-report measures and to set goals using implementation intentions (*if-then* plans). Alongside the app, participants received daily automated personalised text messages corresponding to specific behaviour change techniques (strategies that seek to modify the psychological determinants of behaviour), with content informed by the Health Action Process Approach.

Results: 150 ex-serving personnel were invited to take part in the study, 31 (21%) of whom accepted and downloaded the app. On average, participants started the InDEx app 15.8 (SD 9.4) times during the 4-week period (28-days), received 36.1 (SD 3.2) text messages, consumed alcohol on 14.7 (SD 5.7) days, had 2.1 (SD 0.9) alcoholic drinks per drinking day and remained engaged for 3.6 (SD 0.7) weeks.

Conclusion: App users engaged and used the app regularly as demonstrated by the number of initialisations, interactions and time spent using the app. Future research is needed to assess the efficacy of InDEx in reducing problematic alcohol use.

Keywords: Behaviour change technique, smartphone app, mobile health, alcohol misuse, binge drinking, personalised text messaging.

Introduction

Self-reported alcohol misuse is high amongst personnel of the United Kingdom (UK) Armed Forces (AF), with the trend continuing after they leave service [1]. More than 50% of those who have left military service meet the criteria for hazardous alcohol use, defined as scoring 8 or more on the Alcohol Use Disorders Identification Test (AUDIT; [2], [3]). This prevalence rate is almost double that found in the general population [4], and additionally, 47% of ex-serving personnel binge drinking, defined as six or more units for females and eight or more units (1 UK unit = 8g ethanol) for males per session at least per week [5].

Most people in the general population underestimate their drinking and do not perceive it as problematic, even when the level of consumption is potentially harmful to health [6]; young men are at particular risk of engaging in heavy drinking [6]. This pattern is similar among AF personnel, with less than half of harmful drinkers (AUDIT score ≥20) recognising that they have an alcohol problem [7]. There is a culture of heavy alcohol use in the AF which may be encouraged or maintained by social determinants [8]; therefore, leaving service could provide an opportunity to initiate behavioural change in settings with less peer pressure to conform to social norms.

One easily accessible method of promoting change in alcohol consumption is through the use of a smartphone application (apps). The content of most existing alcohol smartphone interventions is based on public health guidelines regarding safe alcohol limits which may not be *perceived* as credible as they are viewed as state-sponsored and are often at odds with individual beliefs, prevailing social context and perception of consumption [9]–[11]. Furthermore, many users do not maintain engagement with digital interventions [12]. Existing alcohol apps emphasise longer-term health consequences which are seen as remote risks especially by young drinkers [13]–[15], however, a recent meta-analysis suggests that it may be more effective to focus on shorter term detrimental consequences in order to encourage individuals to reduce their alcohol consumption [16], [17].

Most existing alcohol apps include self-monitoring, whereby users are encouraged to regularly record their alcohol consumption within the app [13]. This was found to be the most effective behaviour change technique (BCT) in a review of alcohol interventions [18]; a recent review of computer delivered alcohol interventions suggested that provision of normative feedback, goal review and inclusion of the social norms approach were all associated with better outcomes [19]. There is also evidence that text message interventions can be successful in encouraging people to change their behaviour [20], [21] and further benefits may be gained by incorporating user input to further tailor the text messages.

Currently, there are no published studies describing smartphone apps that seek to customise a brief alcohol intervention using personalised text messages. In this study, we describe the development of the *In*formation about *D*rinking for *Ex*-serving personal (InDEx) app, a tailored 4-week (28-day) intervention, specifically designed for ex-serving personnel who meet the criteria for hazardous alcohol use. The aim of this study was to design an engaging, responsive and usable smartphone app that delivers personalised text messages and gathers alcohol usage data and a feasibility study to test the usability of this app in a hard-to-engage ex-serving population.

Methods

Ethical approval was obtained from the local Research Ethics Committee at the University of Liverpool (reference: #0625).

Participants

Potential participants were eligible for inclusion if they had served in the UK military, were aged 18-65 years, owned an iPhone or Android device released after 2012, were willing to receive daily text messages, currently resident in the UK and were capable of providing informed consent. Those who had an AUDIT score of lower than 8 or greater than 19 were excluded. Participants were participants in the King's Centre for Military Health Research (KCMHR) cohort study [22], [23] who had provided consent to be further contacted regarding additional studies. Participants were asked to use the InDEx app for a period of 4-weeks (28-days). Participants were compensated £40 sterling for their time.

Recruitment

Participants had previously provided contact details in the KCMHR cohort study between May and June 2017. Invitation to participate was sent by email to a randomised sample of participants who had AUDIT scores between 8 and 19. Interested respondents were sent a Participant Information Sheet describing the study and were invited to provide informed consent. Providing informed consent, downloading the app and registering an account constituted enrolment in the study.

App Design and Development

Design and development of the InDEx app was undertaken on an Apple MacBook Pro (OS X El Capitan), 2.5 GHz i5 Intel processor and 8GB RAM. Drifty Co (Madison, Wisconsin, United States) IONIC Framework version 1 [24] was used as the cross-platform framework to enable iOS/Android deployments using Atom [25] as the development environment. See Supplement 1 for an infographic of the InDEx ecosystem.

Specification and Development

The development of the InDEx app was academic-led and supported by experts in smartphone app development, epidemiology, addiction psychiatry and military mental health. The content of the intervention incorporated effective components of previous electronic alcohol interventions (e.g. [19]) and was informed by the Health Action Process Approach (HAPA), which theorises that individuals work through a number of stages in order to change their behaviour, emphasising the motivational processes underpinning behavioural intentions, and the various processes that bring about behaviour change [26], [27]. The delivery of the app was split into 3 stages, based upon the HAPA model, with the content of the app and the text messages corresponding to each stage, for example goal setting was only introduced at stage 2 (and available for use in stage 3). The stages were:

- Stage 1: Normative feedback (defined below), action self-efficacy and self-monitoring
- Stage 2: Maintenance self-efficacy and action planning
- Stage 3: Recovery self-efficacy and coping planning

The features were grouped into modules. The following modules were developed;

1) Account Management: Participants can modify personal information (*e.g.* first name, last name, mobile number), password and app parameters (*e.g.* automatic log out, clear local storage).

2) Screening and Normative Feedback: Captures participant response to a set of questions (defined by the research team) and aggregates responses to produce an infographic representing the participant's alcohol consumption in comparison to the general population.

3) Self- monitoring and Feedback: Records alcohol consumption by participants and provides a range of visual (*e.g.* charts, figures, text) metrics to allow for monitoring of intake.

4) Goal (setting and review): Participants can set goal(s) based on implementation intentions [28] methodology, visual feedback provides feedback on progress towards achieving goal(s) set.

5) Personalised text messaging: Provides a facility to review text messages sent to and from the InDEx central system. Further, participants can rate automated text messages (5-star Likert rating).
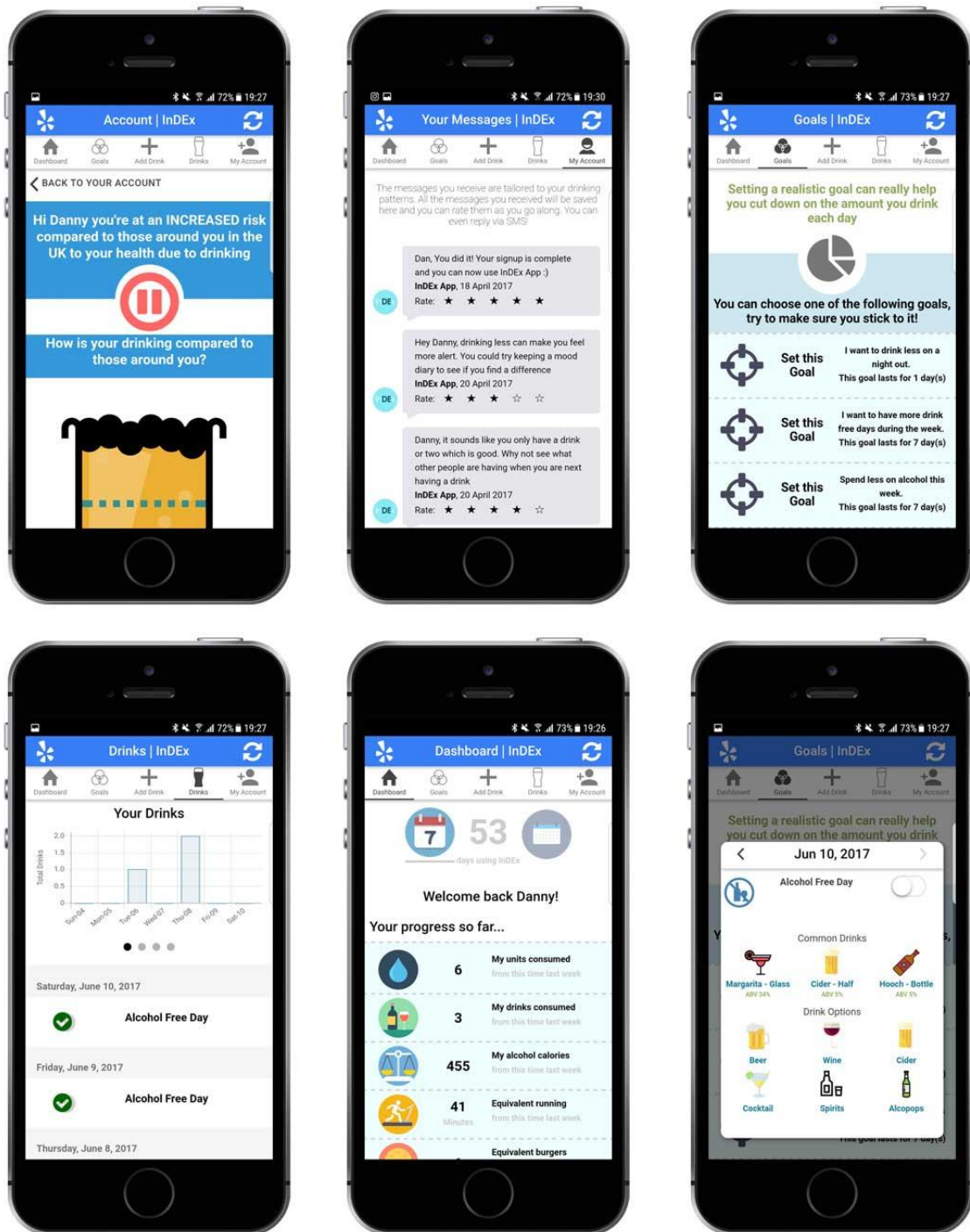
Figure 1. Example of interactions with the InDEx app (left to right, beginning at top): normative feedback, personalised text message history, set a goal, drink diary, dashboard and add a drink.

The app was developed using Agile development methodologies [29], in which an incremental design approach was employed, where each increment built upon the functionality of the previous. Each increment underwent rigorous testing by stakeholder/expert participants sourced from KCMHR and University of Liverpool (n=17) to ensure software quality and usability. Stakeholders/expert participants were requested to provide feedback on usability, language, functionality and errors at each increment point. The development cycle would not progress until functionality and source errors were addressed.

InDEx was administered using a web-based NodeJS [30] server with Application Programming Interface (API) abstraction via Firebase (Google Inc, Mountain View, California, United States) hosted on Digital Ocean MEAN Droplet (Digital Ocean Inc, New York, United States) with access to *all* data heavily restricted; all server interactions were logged and audited daily. Cloud-based services were in London (UK) to comply with local data protection laws and personalised text messages were sent by the web-based server automatically.

To create an account, a participant was required to provide *first name*, *last name*, *email address*, *mobile telephone number*, username, *password* and *in-app informed consent*. All sensitive information such as *password* was encrypted and represented using Bcrypt hashing algorithms (salt factor 10).

The app (exemplars in Figure 1) was designed with limited storage capabilities to avoid concerns regarding confidentiality and privacy of data. Only the username and a secure JSON Web Token, denoting the user's time restricted session, were stored on the local device, with all other data being stored in temporary memory and accessible via API calls. The app was also available for limited offline use.

Operating System Selection

In the UK, four out of five adults own a smartphone, among 18-44 year olds adoption is higher at 91% [31]. The majority (over 90%) of smartphones operate either on Google Android (Google Inc, Mountain View, California, United States) or Apple iOS (Apple Inc, Cupertino, California, United States). Based on available information, the app was developed for use with Google Android and Apple iOS enabled devices.

Personalised Text Messaging

Alcohol interventions which use tailored information to target and perceptions/beliefs and motivations may have the highest utility in positively modifying the motivational behaviours behind high levels of alcohol consumption [32]–[34]. A bank of 180 text messages was developed in line with delivery stages (defined earlier), which were informed by the HAPA framework with discussion groups with ex-serving personnel further refining the messages. Each message had the following characteristics: what day it would be sent, message content and a decision tree defining when it should be triggered. A participant would receive at least one text message each day, up to a maximum of two proportionate to their use of the app. The message bank is available upon request from the corresponding author. See Table 1 for an example of the type of personalised messages sent to participants.

The messages covered a wide range of topics to target beliefs and motivations with the primary aim of increasing the participant's awareness of their drinking habits. The messages were divided into three categories: 1) tailored: personalised to drinking habits, baseline and/weekly measurements. 2) tailored and triggered: tailored to baseline and/contiguous measurements and a specific event occurring. 3) targeted (generic): sent on specific days to highlight inactivity, a new feature or to remind users about an issue. See Table 1 for examples.

Text messages and two-factor authentication codes (used to verify participant's mobile phone number) were sent automatically using Twilio API (San Francisco, United States) via InDEx central

servers. No human involvement was required to send. All text messages sent to participants were visible in the app (My Messages page), participants could rate any messages (rating scale 1-poor to 5-excellent) and also provide text message responses which were stored and displayed.

Table 1. An example of the type of personalised text messages sent to an individual throughout their use of the app. Where parenthesis denotes personalised text fields, with reference to relevant Behaviour Change Technique Taxonomy.

Day to be sent	Type	Related Behaviour Change Technique (BCT)	Message
3	Tailored	Mental rehearsal of successful performance (BCT 15.2)	Hi {name}, try thinking that if I am at the pub this week and feel like drinking then imagine how fresh I will feel the next day if I do not drink a lot
8, 14, 21, 28	Tailored and triggered	Self-monitoring of behaviour (BCT 2.3)	Hi {name}, have you logged your drinks from last week? It's quick and easy to do, just go onto the 'drinks' tab in the app
8	Generic	Action planning (BCT 1.4)	Hi {name}, why not set a goal to reduce the amount you drink? It has been found to really help reduce your drinking, you can start now by clicking on the 'goals' tab in the app

Submission

InDEx was submitted to the Google Play and Apple iTunes App stores via Google Play Developer Console and Apple iTunes Connect, respectively. For testing of InDEx, a private beta group was created; whereby only those who had been given permission were able to access and download InDEx.

Measurement Reporting

All measurements were collected via *Screening & Normative Feedback and Alcohol Reporting & Monitoring* modules, as illustrated in Figure 2. The study team had no ability to modify or influence any measurement response.
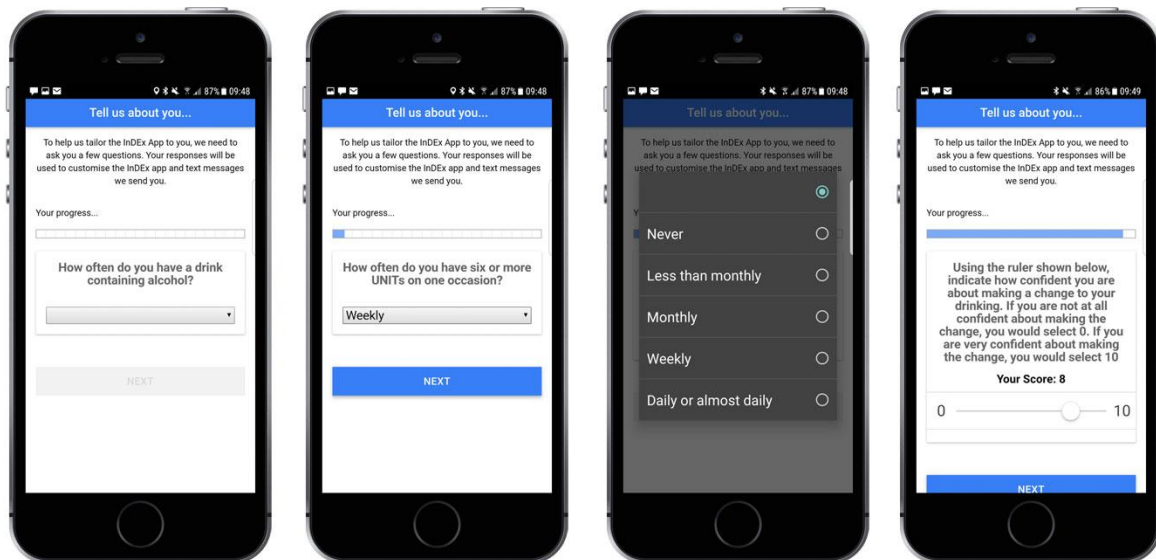
Figure 2. Example presentation and interaction with the InDEx app measurement (questionnaire) module.

Baseline Measurements

Upon successful registration (referred to as 'day zero'), participants completed a number of baseline questionnaires which collected information on age and sex; symptoms of anxiety, depression and post-traumatic stress disorder (PTSD); alcohol consumption; readiness to change and self-efficacy. The following validated scales were used:

1. Age and sex;
2. Alcohol Consumption and Alcohol Use Disorders via Alcohol Use Disorders Identification Test (AUDIT) [2];
3. Symptoms of Anxiety using the two item Generalised Anxiety Disorder Scale (GAD-2; [35]);
4. Symptoms of depression using the two item Patient Health Questionnaire (PHQ-2; [36]);
5. Symptoms of (PTSD) were assessed using the five item Diagnostic and Statistical Manual of Mental Disorders (DSM) PTSD scale (PC_PTSD) [37];
6. Readiness to Change and Self-efficacy Rulers (score range zero to ten) [38].

Baseline measurement responses informed the type of text message a participant would receive. Although this was optional, the baseline measures were asked again upon completion of the study (day twenty-eight).

Weekly Measurements

Participants were asked on days *8*, *15* and *22* to complete the GAD-2, PHQ-2 and the Readiness to Charge and Self-Efficacy Rules.

Any response provided by the participant further informed the tailoring of the text messages, for example, someone meeting the criteria for depression and anxiety could receive a message relating to drinking as a coping mechanism for stress and other strategies they could try.

Reporting Alcohol Consumption

Participants could '*log*' an alcohol beverage or an '*alcohol free day*' via the '*Add Drinks*' tab, Table 2 illustrates the types of alcoholic drink a participant could log. Self-reported alcohol consumption is a standard method for assessing the efficacy of low-intensity interventions [13], [14], [39]. Participants could optionally provide the quantity consumed, strength, price, calories, who they were drinking with and where they were drinking. In addition, if the participant provided consent during installation of the app, their geographical position was recorded.

Table 2. List of alcohol types and categories included in the InDEx app.

Alcohol Category	Alcohol Type (measure)
Beer	Beer (Pint/Half), Shandy (Pint/Half), Ale (Pint/Half), Bitter (Pint/Half)
Wine	Red (Large, Medium, Small), White (Large, Medium, Small), Rose (Large, Medium, Small), Prosecco (Glass)
Cider	Cider (Pint/Half)
Cocktail	Bloody Mary (Glass), Screwdriver (Glass), Martini (Glass), Margarita (Glass), Cosmopolitan (Glass), Mojito (Glass)
Spirits	Cognac (Single, Double), Gin (Single, Double), Rum (Single, Double), Vodka (Single, Double), Tequila (Single, Double), Liqueurs (Single, Double), Sambuca (Single, Double), Sours (Single, Double), Others (Single, Double)
Alcopops	WKD (Bottle), Hooch (Bottle), Smirnoff Ice (Bottle)

Engagement

We measured engagement using a published procedure [40]: the number of times the app was initialised (*e.g.* started when not running in the background), the average session duration (*e.g.* time spent using the app), the number of times a participant performed an interaction (*e.g.* synchronised data, added a drink, added a rating) and the number of weeks in which participants remained engaged with the app (defined as having at least 3 client-server interactions in a week (7 days), other than receiving a text message). Participant engagement was tracked using Google Analytics for Mobile (California, United States) which recorded data when the participant was online or offline. It was not possible to confirm and/or track if a participant read the text messages except in cases where the participant provided a rating from within the app.

Clinical Monitoring

Prior to the study commencing, a risk protocol was developed. Adverse health events were ascertained via automatic monitoring and reporting based on measurement responses and alcohol consumption. A clinician received all warning notifications, pre-defined by the research team, for review. If the clinician felt that any event was clinically significant, they contacted the participant and provided pathways to local support and assistance.

Data Analysis

We calculated descriptive statistics to estimate engagement with the app. Engagement was defined as the number of times the app was initialised, the average session duration, the number of times a user performed an interaction and the number of weeks in which users remained engaged with the app. We estimated user engagement as the mean and Standard Deviation (SD) across participants.

Popularity of pages was inferred from summation of the total number of times each page was viewed by users, and pages were then ranked from highest to lowest number of views.

Frequency of alcohol days, drink free days and alcoholic drinks per drinking day was computed by the average across participants, presented as mean and SD. The number of binge drinking participants was computed per week based on participants having at least one session in which they consumed 6 or more alcoholic drinks, results were presented as proportion and 95% confidence intervals.

Analyses were undertaken using STATA SE 14.2 (STATA Corp, Texas, USA).

Results

Recruitment and Study Enrolment

150 individuals were contacted via email, 13 emails were returned by the email provider as no longer in use, 56 individuals responded to the invitation (40.9%), but 14 of them failed to engage in follow-up and 4 were ineligible due to probable self-reported alcohol dependency. A total of 38 participants were eligible and 31 participants, of which 27 were male (87.1%) and 4 were female (12.9%), went on to download and use the app, representing a registration rate of 22.6%. Of those who joined, 5 (16.1%) were aged 25-39 years, 6 (19.6%) were aged 40-44, 6 (19.6%) were aged 45-49, 6 were aged 50-54 (19.6%) and 8 were aged 55-64 (15.8%). Finally, most participants (83.9%) reported serving in the military for 12 years or more.

Engagement

Participants initialised the InDEx app on average 15.8 (SD 9.4) times over four weeks, engaging in an average of 38 (SD 34.4) sessions and for a mean duration of 57.8 seconds (SD 37.8). Table 3 provides the indicator measures relating to the level of engagement and adherence. 23 (71.2%) of participants used the app every week (maximum 4 weeks), with 27 (87.1%) using the app in the final week, with an average engagement of 3.6 (SD 0.7) weeks (maximum 4 weeks), Table 4 describes the top ten pages viewed by participants, with the Dashboard (36.7%) page being the most popular.

Table 3: Engagement indicators over the study period per participant.

Indicator	Mean (SD)
Initialisations[1]	15.8 (9.4)
Session count	38 (34.4)
Session duration (seconds)	57.7 (37.8)
Interactions[2]	257.2 (114.8)
Weeks active	3.6 (0.7)

[1] App initialisation reflects the app being opened without a background session existing.

[2] Defined as a participant performing a click event (*e.g.* add drink, log out, change page, change drinks diary chart).

Table 4: Top 10 viewed pages within the InDEx app visited by participants within the study period.

Page	Total Views	% of views
Dashboard	4045	36.7
Drinks Diary	3031	27.5
Add Drink	1160	15.1
Account	390	3.5
Goals	379	3.4
Normative Feedback	244	2.2
Weekly Screening	166	1.5
Login	148	1.3
Support	102	0.9
Your Messages	98	0.9
Other pages	766	7

Drinking Behaviours

Table 5 describes the frequency with which participants made a diary entry. Participants consumed alcohol an average of 14.7 (SD 5.7) days, had 13.3 (SD 5.7) drink free days and logged 2.1 alcoholic drinks per drinking day.

Table 6 illustrates the drinking behaviour of participants over the study period. 0.38 of participants were identified as having at least one binge drinking session in week 1, compared to 0.16 in week 4.

Table 5: Average number of entries over the study period per participant. n=31.

Indicator	Mean (SD)
Alcohol days	14.7 (5.7)
Drink free days	13.3 (5.7)
Alcoholic drinks per drinking day	2.1 (0.9)

Table 6: Drinking behaviour of participants over the study period. n denotes the number of diary entries per week. Results provided as mean (SD), n denotes number of participants who logged an alcohol event during the period.

Indicator	Week 1 (n=31)	Week 2 (n=30)	Week 3 (n=29)	Week 4 (n=31)
Alcohol days	3.5 (1.4)	3 (1.4)	2.5 (1.6)	2.6 (1.6)
Drink free days	3.5 (2.2)	3.3 (1.7)	4.2 (2.3)	3.6 (1.6)
Alcoholic drinks per drinking day	2.1 (0.7)	2.3 (0.6)	2.1 (0.3)	1.9 (0.7)
Binge drinking participants [1]	0.38 (95% CI [0.06-0.34])	0.15 (95% CI [0.06-0.33])	0.25 (95% CI [0.07-0.44])	0.16 (95% CI [0.06-0.34])

[1]Defined as having 6 or more alcoholic drinks in a session.

Measurement Responses

Table 7 summarises participants' baseline and weekly self-reported measurement responses. Participants demographics reflect similar composition to that of the general ex-serving population [22], [23]. On average, participants had a baseline mean AUDIT score of 10.9 (SD 2.6), indicating a potentially hazardous alcohol consumption, with an average readiness to change score of 4.4 (SD 3.2) indicating a willingness to change. A small change in AUDIT score was observed for participants who self-reported for Day 0 (Registration) and Day 28 (Final Day) based on mean score; however, they would still be classified as hazardous drinkers.

Table 7: Self-reported baseline and weekly measurement responses.

Variable	Mean (SD)				
	Day 0 (n=31)	Day 8 (n=25)	Day 15 (n=25)	Day 22 (n=21)	Day 28 (n=22)
GAD					
Score	0.6 (1.2)	0.4 (1.3)	0.7 (1.3)	0.4 (1.1)	0.6 (1.5)
PHQ-2					
Score	0.7 (1.4)	0.5 (1.2)	0.5 (1.1)	0.5 (1)	0.5 (1.3)
AUDIT					
Score	10.9 (2.6)	-	-	-	9.5 (3.6)
Self-efficacy					
Ruler Score	6.7 (2.7)	5.9 (3)	4.9 (3.2)	6.3 (2.5)	4.5 (3.1)
Readiness					

	Ruler Score	4.4 (3.2)	4 (3.3)	3.4 (2.8)	4.9 (3.2)	3.7 (2.7)

Text Messaging

A total of 1083 (mean 36.1, SD 3.2) text messages were sent, with 18 replies and 42 text message ratings, the mean rating of content suitability was 2.5 (SD 1.3). One participant withdrew consent for receiving text messages on day 16 of the study.

Discussion

Principal Findings

In this feasibility study, we assessed indicators of engagement and adherence with InDEx. We measured engagement and adherence using three indicators: number of times the app was initialised (mean: 15.8), the average session duration (mean: 57.7 seconds) and number of app interactions (mean: 257.2). Two thirds of participants used the app every week and the majority were still using it in the final week (87.1%). These engagement indicators suggest that participants were highly active in using InDEx during the study period. On average, most participants reported drinking on about half the days in the study period and the other half were drink free, with a one-third of participants' identified as binge drinking in the first week, reducing to less than a quarter in the final week.

The pattern of use within InDEx can be described in terms of the frequency with which certain pages were accessed. In this study, the most frequently opened page was the *Dashboard*, the *Drinks Diary* page was the second most frequently accessed while *Add Drinks* was third. The top three most viewed pages accounted for 79% of all app views, which shows that most participants used the InDEx app primarily for monitoring drinks and the other features were not used as frequently. InDEx offered the ability to set a goal using *if-then* format, however participants used this feature rarely even after encouragement to set a goal via SMS text message and in-app prompts. This may be due to the sample not believing they have a problem, showing a lack of unwillingness to change their behaviours or they were unable to navigate to/set a goal, this will be explored further in future work.

We applied BCT techniques [18] to create a smartphone app which incorporated a tailored text messaging framework in an attempt to engage with users who are usually hard to reach [41]–[43]. It is difficult to ascertain if, and to what extent, text messages encouraged alcohol reduction or app engagement. Future work is needed to assess the latency between receiving a text message and engaging with the app. InDEx app takes advantage of a delivery method which circumvented the practical and psychological barriers such as ability to handle a civilian life faced by ex-service personnel by utilising digital technology. Participants were compensated for registering, but had no financial incentive to use the app for the study period; nevertheless, they spent an average of 3.6 weeks engaging with the app.

InDEx has certain features which do not feature in other currently available alcohol apps. Firstly it offers a user-centred, personalised design; the interactive features of the app were generated through discussions with stakeholders and ex-serving personnel and were developed using an iterative development framework to ensure that they were properly focused. The second major facet of the app was the use of BCTs in conjunction with data collected via the app to personalise the text messages sent to participants. These features exploit contemporary technology which, as our feasibility study suggests, promotes the acceptability of the InDEx app and encourages users to engage with the app to log and thereby self-monitor their alcohol consumption.

To the authors' knowledge, this was the first study to use text messages which were embedded in an app to specifically focus on improving engagement and hopefully change attitudes and beliefs related to alcohol consumption. While several studies have sought to investigate the impact that

text messages and tailoring can have on adherence, the combined use of the two within the framework of an online app has never been attempted before. We sought to describe the process of tailoring and the deployment of the app using digital technology. We hope that, despite the small sample size, making such information available can help guide future studies aiming to employ similar methods.

Limitations

Despite the study strengths, our findings has some limitations. First, baseline, weekly alcohol consumption data was self-reported, albeit using reliable, consistent, and 'gold standard measurements'. As with all self-report measures, recall and social desirability biases may have impacted responses to be more favourable than if collected using objective methods, such as transdermal alcohol monitoring. Second, participants were asked to use the InDEx app for 28 days. While the app appears feasible and acceptable to users during this period this study was not designed to ascertain the long-term benefits. Third, our findings may not be generalisable to other populations including other groups of ex-serving personnel due to the limited sample size. Fourth, the sample size and design was appropriate for feasibility testing, but not for assessing efficacy of the app. Finally, we studied InDEx in isolation and did not directly compare it with other app-based interventions.

Conclusions

In summary, the results of this feasibility study suggest that the InDEx app was feasible to implement and acceptable to participants who typically engaged with the app for most of the study duration. Future research is needed to evaluate the engagement with and efficacy of InDEx for the reduction of alcohol consumption and binge drinking in this population.

Declarations

Conflicts

None declared.

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Supplements

Supplement 1: Infographic of the InDEx App Ecosystem