

Developing a Digital Therapeutic to Reduce Harmful Use of Alcohol

Can Curb, a mobile application supporting healthy behaviour change, predict alcohol cravings and consumption?

Dr Helen Anderson (ST6 higher trainee in dual general and older adult psychiatry, South London and Maudsley NHS Foundation Trust; Digital Health Fellow, Curb Health)
 Dr Romayne GadelRab (Consultant, South London and Maudsley NHS Foundation Trust; Advisor, Curb Health)
 Dr David McLaughlan (Visiting Consultant, the Priory Group; Co-Founder and Chief Medical Officer, Curb Health)
 Dr Christopher Lovejoy (Founding AI Engineer, CoHelm Ltd)

BACKGROUND

The harmful use of alcohol causes a high burden of disease and propagates significant social and economic ills. In England, an estimated 10 million people regularly exceed the Chief Medical Officers' low-risk drinking guidelines, including 1.7 million who are high risk drinkers and 600,000 who are alcohol dependent. Despite this, the number of people receiving treatment for their alcohol use has been falling, and alcohol related hospital admissions have been steadily rising (1). The need for preventative approaches in alcohol care has never been greater.

Digital health interventions are becoming increasingly popular due their accessibility, convenience, cost-effectiveness and scalability. Curb Health are developing technology that uses machine learning to recognise each person's unique behaviour patterns around alcohol cravings, and then offer personalised interventions when support is most needed.

AIMS

- The aims of this study were to:
1. Understand what measurable information can help predict alcohol cravings.
 2. Explore building a machine learning model which uses this to generate predictions.

METHODS

Data for this study were collected directly from the Curb Health mobile application (app), 'Jitai', and from wearable devices. Data included demographics, health and physical activity (e.g. step count, total sleep time and heart rate variability) and self-reported information (including presence of cravings and self-reported mood).

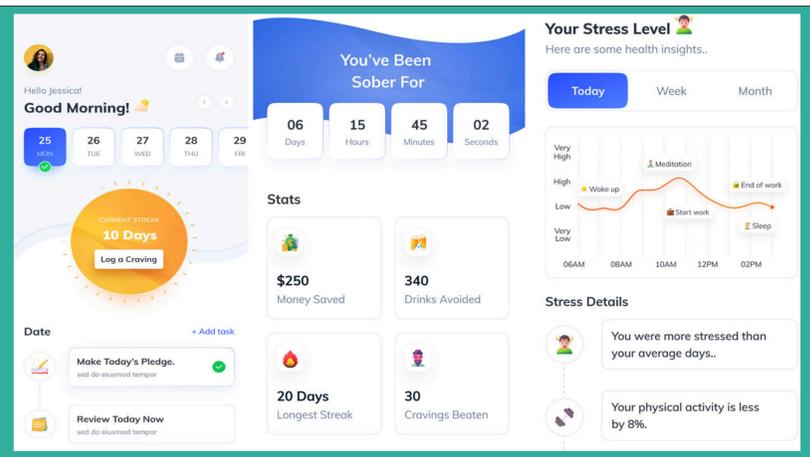


Figure 1: Example screens from the Curb Health app, 'Jitai'.

All data were aggregated to daily level and a logistic regression model was trained to predict whether a generic individual was at high or low risk of craving or drinking alcohol each day. Only users for which both a craving log and at least one type of input data, and only variables with less than 50% of missing data, were included in the final dataset. Outlier data points were then removed, and input data were normalised using min-max normalisation to ensure all input features were on the same scale.

RESULTS

From 1st November 2022 to 30th April 2023, 5049 users uploaded health-related data and 2958 cravings were logged in the app. After cleaning (as outlined above), 243 user's data were included in the final dataset.

Our final dataset consisted of the following variables:

- Total amount of time exercising in the day
- Total number of steps taken in the day
- Total distance covered in the day
- Average reported mood during the day
- Total amount of sleep the previous night (in minutes)
- The average heart rate variability (HRV) across the day
- Age

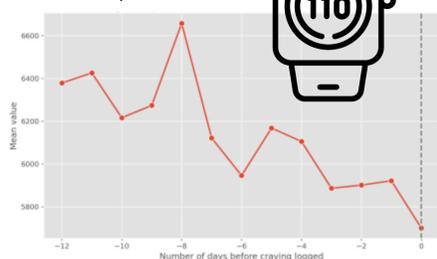


Figure 2: Mean daily step count for all users in the final dataset (n=243) in the days running up to a craving (denoted here as Day 0)

The following information was excluded from our final dataset due to an insufficient amount of recorded data: blood glucose values, amount of time spent in meetings, amount of time spent in mindfulness sessions.

Figure 3: Mean total minutes of sleep for all users in the final dataset (n=243) in the days running up to a craving

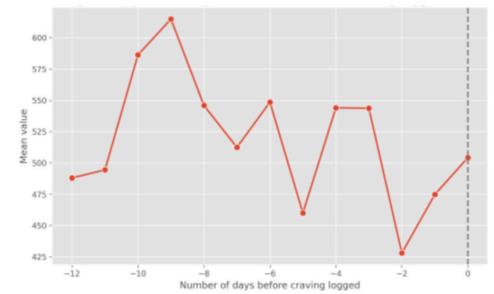
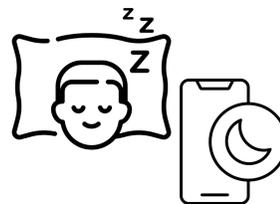


Figure 4: Mean daily heart rate variability (HRV) in milliseconds for all users in the final dataset (n=243) in the days running up to a craving

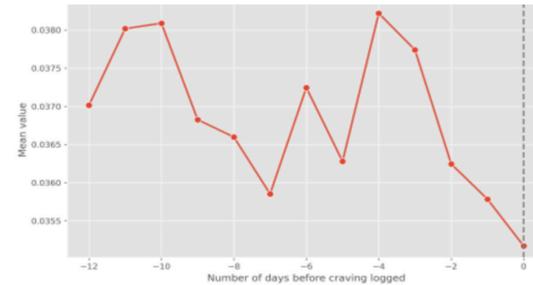
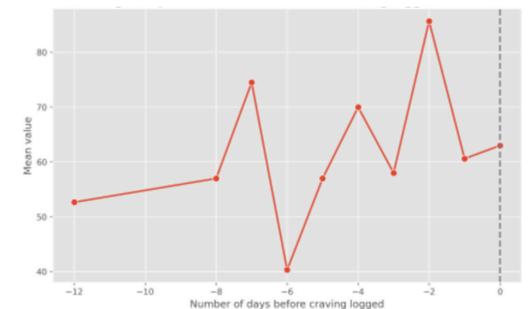


Figure 5: The mean self-reported mood for all users in the final dataset (n = 243) in the days running up to a craving



We observed the following trends in the days preceding a logged instance of alcohol craving:

- A decrease in step count
- A dip in sleep 2 days prior to a logged craving
- A decrease in heart rate variability (HRV)
- A dip from peak self-reported mood

Attempts to train a simple machine learning model were not possible due to significant overfitting. While almost 3000 cravings were logged, low temporal overlap with other input data meant only 100 instances of cravings could be used as training data.

CONCLUSIONS

This study demonstrated trends in measurable health parameters in the run up to an alcohol craving. Prior to a logged craving, we found a decrease in daily step count, a reduction in sleep, a decrease in heart rate variability and a dip from a high to a low self-reported mood. Our findings are in keeping with previous reports in the literature, for example the relationship between sleep patterns and alcohol craving (2,3) and the role of lower HRV in alcohol addiction (4,5). Knowledge of these trends could be used to offer adaptive interventions to reduce risk of craving, for example prompts to increase physical activity and improve sleep hygiene.

Although we were unable to train a machine learning model, this study suggests that this would be feasible with access to a larger dataset with more instances of input information (e.g. self-reported mood) overlapping with logged cravings. Access to more data may also lead to discovery of previously unknown predictors of craving, as well as enhancing the granularity of the prediction. Potentially, predictions could be made for smaller time windows and more personalised to the individual.

Subsequent app iterations are optimising the quality of data collected, as well as integrating new features such as GPS tracking to examine the effect of physical surroundings on cravings. In time, we aim to broaden the application of this technology to other harmful and unwanted behaviours including nicotine and cocaine addiction.



References:

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