Poster: Mobile Health for Alcohol Recovery and Relapse Prevention

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***Abstract*—Alcohol related disorder has increasingly become a serious public health issue. Stress detection and intervention is considered a key element in a treatment strategy towards preventing alcohol dependent individuals from relapsing. In this paper, we present a proof-of-concept approach to study the usability of a wearable device and viability of a mobile health application to prevent alcohol relapse by detecting moments of stress and providing adaptive interventions in real-time.**

I. Introduction

Recent epidemiological data indicate increasing rates of alcohol use and alcohol-related disorders among the U.S. adult population [1]. National data also indicate that treatment admissions are highest for patients suffering from alcohol use related disorders, relative to all other substances. However, these admissions represent only a small proportion of all alcohol-dependent individuals who might benefit from treatment [2]. Mobile health (mHealth) technologies in which patients receive personalized interventions on mobile devices (e.g., smartphone apps) represent a potential strategy to reduce this treatment gap [3]. Due to the intense physiological response induced in the human body to perceived stress, physiological signals such as heart rate, electrodermal activity, skin temperature, electromyography, electrocardiography, and respiration rate lend themselves best to stress monitoring [4].

This research was designed as a proof-of-concept study to provide valuable information toward the development of a mHealth application for alcohol-dependent patients to prevent relapse to alcohol (see Figure 1). Based on a large literature that demonstrates alcohol relapse is associated with physiological stress [5]–[7], the proposed study included three components: 1) a 10 or 11-day daily diary study using ecological momentary assessments (EMA) of self-reported emotions, cravings, and stress via an online survey, prompted four times daily; 2) a wearable sensor device (Empatica E4 wristband) that captured continuous, physiological markers of stress, including heart rate, skin temperature, bodily movement, heart rate variability, and skin conductance; and 3) structured qualitative interviews to assess daily alcohol use, using a timeline followback calendar, and to validate self-reported and physiological markers of stress.

The current analyses addressed three study goals. First, we assess the feasibility of the study protocol by describing recruitment and compliance rates. Second, we describe the correspondence between the self-reported measures of stress events (EMA surveys) and physiological markers of stress (wearable sensor device). Third, we investigate acceptability and barriers to the study protocol.

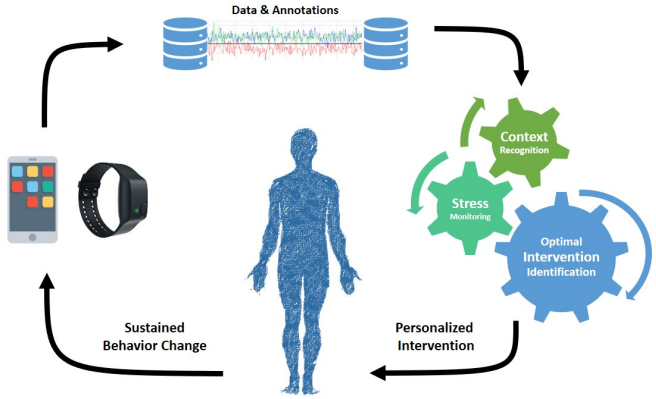

Fig. 1. A mHealth system for automated health assessment and intervention for sustained behavior changes in people suffering from alcohol use disorder.

II. Data Collection

Participants (N = 11, 10 female) were recruited from a larger study among adult patients receiving outpatient treatment as usual for mental health and alcohol use disorders at a treatment agency in the state of Washington. All participants indicated heavy alcohol use in the past 60 days and met Diagnostic and Statistical Manual of Mental Disorder (DSM-V) criteria for moderate or severe alcohol use disorder (AUD). Out of 20 individuals screened, a total of 12 agreed to participate in the study (2 did not meet eligibility criteria, 6 declined, and 1 dropped out). On average the participants were involved with the study for 14 days with the range of $7 - 17$ days. In the first baseline in-person interview the consent of the participants was obtained and the participants were trained to use the E4 wristband and EMA surveys. The participants were instructed to wear the E4 wristband on the same wrist each day during waking hours and to remove the device each night prior to sleep or when bathing. Moments of heightened stress were identified in two ways. First, participants were asked to press the "event mark button" on the E4 wristband any time they felt "more stressed, overwhelmed, or anxious than usual." Second,

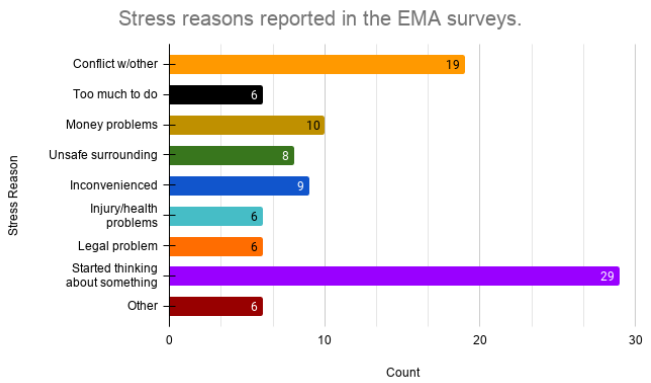

Fig. 2. The number of times each reason for stress was selected by the participants in EMA surveys.

the EMA survey included a question that asked, "Since [last assessment], have you experienced a time when you felt more stressed, overwhelmed, or anxious than usual?" During the course of participation, 2 follow up interviews were conducted to asses perceived stress events. A final qualitative interview was conducted at the end of the study to ascertain usability and comfort issues associated with the E4 wristband.

III. Preliminary Findings

We collected various bio-markers using the E4 wristband and survey responses from phone surveys conducted four times a day (early morning, noontime, afternoon, and bedtime).

A. Physiological data from E4 wristband

Overall, a total of 1698 hours of physiological data were collected from 11 participants, with 11.5 hours of recording each day. A total of 409 events were tagged by the participants as moments of stress using the button available on the E4 wristband. On average the participants tagged 37.18 events with the range of $19 - 87$ events.

B. EMA survey data

10 participants completed the EMA surveys for a total of 343 surveys (96 morning, 90 midday, 76 afternoon, 81 evening). Perceived stress events were reported in 99 (29.6%) of these assessments. On average, participants completed a mean of 34 surveys (range: $24 - 39$) for a mean completion rate of 81.2 (range: $54.6 - 100$). The mean number of stress events reported in the EMA survey was 9.9 (range: $1 - 24$). On average, participants reported stress events in 33.3% of assessments (range: $2.5\% - 96.0\%$). On surveys marked with stress events, morning surveys were most likely to be marked with stress (33 out of 99) and afternoon surveys had the least number of stress events (20 out of 99). For each event, participants also indicated the reason(s) for feeling stressed by selecting among 9 options. Figure 2 displays the number of times each reason for stress was selected by the participants.

C. Follow up interviews

In 2 follow up sessions and the final interview the participants were asked to describe in detail any stressful events they remembered and also answered general questions about the usability of the E4 wristband. On average, the participants remembered 4.63 events (range $1-8$), and details about a total of 51 events were recorded during the follow up sessions.

Almost all of the participants reported general satisfaction with wearing the device, although 2 participants noted that the device was bulky and 2 other participants stated that "*it fits too tightly*". One participant mentioned that the device looked like an "*ankle monitor*" and wished that the wristband was more aesthetically pleasing. Notably, three participants stated that pressing the event marker button provided a degree of satisfaction and redirected their attention to the stressful event. Sample quotes from the participants included the following:

- *I liked the process of pressing the button. Would recommend this to other people*.
- *I liked pressing "the panic button" when I felt stressed. I think it stops and makes you think and slow down a bit. This is probably good for my high blood pressure and mental health. I slow down and take a minute*.

IV. Conclusion

In this paper, we presented the preliminary findings from our study. In particular, our results suggest that a wearable device can be used to collect physiological data in people suffering from alcohol use disorder. EMA surveys and follow up interview sessions were also crucial to better understand perceived stress events. However, a wearable sensor system provides the most efficient way to mark stress events. We also note that the wearable device aesthetic appeal and ease of use is important when considering which device to use for data collection. Also, EMA surveys should be made as easy to complete as possible to encourage the participants to complete more number of surveys.

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