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Assessment of alcohol intake: Retrospective measures versus a smartphone application

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HIGHLIGHTS

- Real-time assessment of drinking behaviour using a smartphone app was explored.
- Participants logged more drinking days via the app compared to Timeline Followback.
- Total intake was higher when recorded using the app relative to Timeline Followback.
- The app captured a greater number of high intake episodes than Timeline Followback.
- The app showed faster rate of consumption than the Alcohol Use Questionnaire.

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ABSTRACT

Introduction: Research investigating problem drinking often relies on retrospective measures to assess alcohol consumption behaviour. Limitations associated with such instruments can, however, distort actual consumption levels and patterns. We developed the smartphone application (app), CNLab-A, to assess alcohol intake behaviour in real-time.

Methods: Healthy individuals (N = 671, M age 23.12) completed demographic questions plus the Alcohol Use Questionnaire and a 21-day Timeline Followback before using CNLab-A for 21 days. The app asked participants to record alcohol consumption details in real time. We compared data reported via retrospective measures with that captured using CNLab-A.

Results: On average, participants submitted data on 20.27 days using CNLab-A. Compared to Timeline Followback, a significantly greater percentage of drinking days (24.79% vs. 26.44%) and significantly higher total intake (20.30 vs. 24.26 standard drinks) was recorded via the app. CNLab-A captured a substantially greater number of high intake occasions at all levels from 8 or more drinks than Timeline Followback. Additionally, relative to the Alcohol Use Questionnaire, a significantly faster rate of consumption was recorded via the app.

Conclusions: CNLab-A provided more nuanced information regarding quantity and pattern of alcohol intake than the retrospective measures. In particular, it revealed higher levels of drinking than retrospective reporting. This will have implications for how particular at-risk alcohol consumption patterns are identified in future and might enable a more sophisticated exploration of the causes and consequences of drinking behaviour.

1. Introduction

In research focusing on the causes and consequences of problem drinking, accurate assessment of alcohol use – both in terms of volume and pattern – is vital. Currently, such research relies primarily on data collected using well-validated and reliable retrospective self-report measures administered in the laboratory. Retrospective measures can be broadly categorised into two main types: quantity-frequency surveys and retrospective diaries. In their simplest form, quantity-frequency surveys ask participants to specify how much they usually drink and how often (Utpala-Kumar & Deane, 2010). This permits average daily consumption to be determined rapidly and efficiently, but does not allow for any investigation of pattern of intake (Del Boca & Darkes, 2003). Moreover, such surveys have been found to under-estimate total consumption by almost 30% when compared to prospective daily assessments (Heeb & Gmel, 2005) and up to 50% when compared to per

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capita sales of alcohol (Stockwell et al., 2004; Stockwell, Zhao, Chikritzhs, & Greenfield, 2008). This discrepancy is attributed, at least in part, to difficulties participants have conceptualizing their usual consumption, especially if their intake is highly variable across drinking occasions, a tendency to overlook occasional high intake sessions, and recall bias (Del Boca & Darkes, 2003; Stockwell et al., 2004). Participants are consequently thought to report modal rather than average consumption in response to quantity-frequency surveys (Utpala-Kumar & Deane, 2010).

The accuracy and detail of data obtained from quantity-frequency surveys can be enhanced somewhat by the inclusion of additional components. Beverage-specific questions, an explicit reference period, and including items that assess high intake behaviour have all been found to generate increased estimates of consumption and more comprehensive information about pattern of intake (Dawson, 2003; Del Boca & Darkes, 2003; Rehm, 1998). A number of measures adopt this type of approach. The Alcohol Use Questionnaire (AUQ), for instance, combines beverage-specific quantity-frequency questions about weekly intake over a six-month period with items that assess drinking behaviour and subjective effects (Mehrabian & Russell, 1978). Weekly intake, rate of consumption, and a composite binge score index can be derived from this measure (Townshend & Duka, 2002). Although this provides some insight into total intake and pattern of consumption, it nonetheless has still been found to under-estimate total intake when compared to prospective daily assessments (Townshend & Duka, 2002). Furthermore, binge behaviour is frequently determined based on tertile or median splits of the sample (Townshend & Duka, 2005; Townshend, Kambouropoulos, Griffin, Hunt, & Milani, 2014). Results are therefore inextricably bound to the sample studied (Bø, Billieux, & Landrø, 2016).

Retrospective diary methods of collecting alcohol consumption information ask participants to recall day-to-day intake over a preceding designated time period (Del Boca & Darkes, 2003). Alcohol Timeline Followback (TLFB; Sobell & Sobel, 1992) is a commonly employed, well-validated example of this technique. Such diaries furnish researchers with considerable information pertaining to volume consumed and pattern of intake (Kypri, Langley, & Stephenson, 2005). In a review of more than thirty papers, however, Feunekes, van't Veer, van Staveren, and Kok (1999) found these diaries significantly under-estimate consumption levels – by about 20% – when compared to quantity-frequency surveys and prospective assessments. A study comparing repeated 7-day TLFB with 30-day TLFB revealed how more frequent assessments identified higher volume of intake, greater frequency of binge episodes and fewer abstinent days, with the absolute value of volumetric discrepancies between the two measures increasing as a function of length of recall (Hoeppner, Stout, Jackson, & Barnett, 2010). Longer assessment time periods yield less precise data (Ekholm, 2004); however, collecting data over narrow time frames distorts alcohol consumption information because drinking behaviour has been found to vary considerably from week to week (Del Boca, Darkes, Greenbaum, & Goldman, 2004; Goldman, Greenbaum, Darkes, Brandon, & Del Boca, 2011).

Real-time assessment of alcohol intake and pattern of consumption potentially overcome disadvantages associated with retrospective measures. Such assessment enables drinking to be recorded repeatedly, in close proximity to the event, often in the natural environment, and in the absence of the researcher (Trull & Ebner-Priemer, 2013). To date, studies comparing daily intake recorded via hand-held electronic devices and interactive voice response systems with that captured using retrospective methods have yielded varied results. In some cases, real-time assessments have revealed significantly higher consumption (Searles, Helzer, Rose, & Badger, 2002) or greater variability of intake (Carney, Tennen, Affleck, Del Boca, & Kranzler, 1998), while in others no significant differences have been identified (Bernhardt et al., 2009). Moreover, such devices pose a significant cost to researchers, potentially limiting the scope of the research (Kuntsche & Labhart, 2013; Trull & Ebner-Priemer, 2013). They additionally place considerable burden on participants, possibly diminishing compliance (Kuntsche & Labhart, 2013; Shiffman, Stone, & Hufford, 2008). With the advent of smartphones and application technologies (apps), real-time assessment limitations can be reduced. Researchers can take advantage of high smartphone ownership (Poushter, 2016), for instance, by using apps on participants' own devices to collect data. Apps enable considerable information about drink type, size, and ethanol content to be quickly logged, reducing the burden on participants in terms of time required to record information. Their capacity to compute rate of consumption and standard drink calculations reduce the potential for inaccurate reporting.

Few studies to date have validated app assessment of alcohol intake and pattern of consumption with retrospective measures. Monk, Heim, Qureshi, and Price (2015) found healthy participants ($n = 51$) recorded greater consumption when using an app for 7 days as compared to when such information was gathered retrospectively using researcher-generated beverage-specific surveys. Similarly, alcohol intake recorded daily via an app over a six-week period was shown to be significantly higher than when reported using TLFB; indeed, discrepancies between the measures increased over time (Dulin, Alvarado, Fitterling, & Gonzalez, 2017). Participants ($n = 25$) in this study, however, were diagnosed as alcohol dependent and were simultaneously undertaking treatment modules deployed by the app (Dulin et al., 2017). In both studies, sample size was relatively modest and retrospective data were collected after real-time recording, potentially enhancing participants' recall of drinking information and thus underestimating differences between real-time and retrospective data. This later point is a limitation often cited by researchers in this area (Carney et al., 1998; Perrine, Mundt, Searles, & Lester, 1995; Toll, Cooney, McKee, & O'Malley, 2006). Moreover, neither study examined differences in pattern of alcohol intake across measures.

The aim of this study was to examine differences between alcohol consumption information captured using an app for 21 days with data recorded via traditional, well-validated retrospective measures – namely, 21-day TLFB and the AUQ – in a large healthy sample. We chose a 21-day time frame in order to capture drinking variability; this appears to be particularly important when assessing binge patterns of alcohol intake (Courtney & Polich, 2009). We hypothesised that, relative to retrospective reports, indices related to alcohol intake and pattern of consumption would be greater when recorded via CNLab-A. Further, we expected app data to better accord with Australian Bureau of Statistics (ABS) apparent per capita alcohol consumption.

2. Methods

2.1. Participants

The present study consists of data from 671 participants (M age 23.12, $SD = 7.24$, range: 16–56, 70% female) that form a subset of an ongoing project – entitled CheckMyControl – investigating the relationship between alcohol use and various social and cognitive factors in the healthy population (see Fig. 1). Participants were recruited via adverts posted in and around the University of Melbourne, researcher networks, and social media posts. The University of Melbourne Human Ethics Committee approved the study in accordance with the standards for ethical research of the National Health and Medical Research Council.

2.2. Procedure

After reading a plain language statement and providing informed consent, participants answered a brief online researcher-devised demographic survey. They then completed the Alcohol, Smoking and Substance Involvement Screen (ASSIST), Alcohol Use Disorders Identification Test (AUDIT), AUQ, and a 21-day TLFB. Finally, participants were required to download and use a smartphone app for