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RESEARCH ARTICLE

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The effects of acute alcohol withdrawal on sleep

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Abstract

Objectives: Although sleep disturbances are prominent during alcohol withdrawal, less is known about the specific components of sleep that are disturbed prior to and during acute detoxification. This study aimed to determine whether specific sleep components are affected prior to and during acute detoxification and their relationship to psychological distress.

Methods: Twenty-nine participants were recruited from a residential detoxification service in Melbourne, Australia, and completed both subjective methods of sleep and distress, in addition to wearing an actigraphy device.

Results: Daytime dysfunction, sleep quality, and sleep disturbances were the components that were most disturbed in the month prior to admission, and poor sleep efficiency was detected during acute withdrawal using actigraphy. A significant association was found between sleep and psychological distress in this group.

Conclusions: Specific disturbances in sleep are experienced prior to and during acute alcohol withdrawal, suggesting that tailored interventions may be effective in the treatment of sleep deficits during these periods.

KEYWORDS

alcohol, daytime dysfunction, detoxification, insomnia, sleep, withdrawal

1 | INTRODUCTION

Disturbed sleep is commonly reported following heavy alcohol consumption (Feige et al., 2006; Stein & Friedmann, 2006) and withdrawal (Drummond, Gillin, Smith, & DeModena, 1998). More than 70% of those with alcohol dependence experience further sleep difficulties during subsequent abstinence (Brower, 2003). Sleep disturbances typically begin 6–24 hr after consumption of the last alcoholic drink (Muncie Jr., Yasinian, & Oge, 2013; Vitiello, 1997) and continue up to 5 months post-withdrawal (Brower, 2001). These long-term disturbances are associated with an increased propensity to relapse (Brower, 2003). Despite this, previous studies have inconsistently used validated tools to examine which facets of sleep are disturbed (Arnedt, Conroy, & Brower, 2007). This is important given that (a) validated instruments are essential in the diagnosis of insomnia complaints (Mayers & Baldwin, 2006; Shekleton, Rogers, & Rajaratnam, 2010), and (b) sleep issues experienced either prior to or during acute withdrawal may contribute to an increased risk of future relapse if they remain untreated (Arnedt et al., 2007). One possible link between poor sleep and relapse may involve mood or psychological distress impacting on the sleep period. Strong associations between poor sleep and diminished affect have been reported in both nondependent (Rajaratnam et al., 2011) and dependent populations (Ogeil & Phillips, 2015), with alcohol also inhibiting complex cognitive abilities and next day performance (Rohsenow et al., 2010). Links between heavy drinking and poor sleep have also been reported in college students (Miller et al., 2017) and adults (van Schrojenstein Lantman, Mackus, Roth, & Verster, 2017), with poorer sleep associated with extended and more severe hangover symptoms (van Schrojenstein Lantman, Mackus, et al., 2017) and increased next day sleepiness (van Schrojenstein Lantman, Roth, Roehrs, & Verster, 2017). Sleep has also been examined in outpatients following treatment for alcohol dependence (Currie, Clark, Rimac, & Malhotra, 2003; Foster & Peters, 1999) and may play a role in the development of a subsequent mood or psychiatric disorder (Roberts, Roberts, & Duong, 2008).

Disturbed sleep post-alcohol withdrawal is an important predictor of relapse, however, inconsistencies exist in the literature in relation to the specific components of sleep that are associated with relapse (Foster, Marshall, & Peters, 1998). These facets have not thoroughly been investigated prior to entry or during acute withdrawal, periods which are critical to long-term recovery from alcohol dependence (Kosten & O'Connor, 2003). The present pilot study investigated measures of sleep and mood prior to detoxification (using subjective questionnaire measures) and during the acute detoxification period (using actigraphy and sleep diaries) in a primary alcohol-dependent population. It was hypothesised that both self-reported sleep quality and objective assessment of sleep would be poor both prior to and during detoxification and that significant associations would be found between the experience of poor sleep and psychological distress.

2 | METHODS

2.1 | Participants

Twenty-nine participants (15 males and 14 females) with a mean age of 45.0 years (range: 29–68 years) were recruited following their admission to a residential detoxification service in Melbourne, Australia.

2.2 | Measures

Sleep was assessed using both objective (Actigraphy, Philips, Spectrum PRO devices) and subjective (questionnaires and sleep diaries) methods. The questionnaires administered are discussed in the following sections.

2.2.1 | Pittsburgh Sleep Quality Index

An instrument consisting of 19 items, which collectively generate seven components—including sleep latency, daytime dysfunction, sleep duration, subjective sleep quality, sleep disturbances, use of sleeping medications, and habitual sleep efficiency (Buysse, Reynolds, Monk, Berman, & Kupfer, 1989). These components are combined to yield a global Sleep Quality score with scores >5 indicative of poor sleep quality. The Pittsburgh Sleep Quality Index (PSQI) has a Cronbach's α of .83 indicative of high reliability (Buysse et al., 1989).

2.2.2 | Epworth Sleepiness Scale

The Epworth Sleepiness Scale (ESS) consists of eight items that combined give a score of excessive daytime sleepiness. Scores above 10 suggest the presence of excessive daytime sleepiness. This validated tool has high internal consistency (Cronbach's α of .88) and reliability (Johns, 1992; Wu et al., 2012).

2.2.3 | K-10

A 10-item scale used to assess psychological distress (Harrison et al., 2014; Kessler et al., 2002). The 10 items are combined to give a global score out of 50 with subsequent categorisation as used within Australian primary care settings to identify severity of distress (Australian Bureau of Statistics, 2012). Scores above 30 indicate that a person is likely to have a severe mental disorder, scores of 25–29 indicate that a person is likely to have a moderate mental disorder, and scores of 20–24 indicate that a person is likely to have a mild mental disorder. The K-10 has excellent internal consistency and reliability (Cronbach's α of .93; Kessler et al., 2002).

2.2.4 | Insomnia Severity Index

A seven item questionnaire used to screen for insomnia. Score of 8–14 represent subthreshold insomnia, 15–21 indicate moderate severity insomnia, and 22–28 indicate severe insomnia. The Insomnia Severity Index (ISI) has been found to be a reliable and validated method of determining insomnia severity (Bastien, Vallières, & Morin, 2001).

2.3 | Procedure

The study received ethics approval from the Eastern Health Human Research Ethics Committee. Potential participants were identified by clinical staff at the community detoxification unit following admission and were approached by the researchers if they were interested in participating. After providing consent, participants completed the sleep and psychological distress measures, which assessed these outcomes in the previous month (prior to their stay at the detox). During their stay, sleep was assessed using an Actiwatch and a sleep diary completed daily. Data collection periods varied with five participants spending 3–4 days in the study, 15 for 5–7 days, and two remaining in the study for 8–10 days.

2.4 | Data analysis

Pearson correlations were used to identify relationships between psychological distress and sleep outcomes. Actigraphy outcomes examined were total sleep time, wake after sleep onset (WASO), sleep onset latency, sleep efficiency, and sleep fragmentation; with the data used in combination with the sleep diaries to obtain accurate sleep and wake times and values for sleep latency and efficiency measures (Lockley, Skene, & Arendt, 1999). Sleep and wake times recorded in the sleep diary were manually entered into the Actiwatch log. However, when the sleep/wake time reported differed with the times stated by the actigraphy algorithms by 30 min or more, the bed/wake time was determined by identifying the point on the actigraph where a substantial change in activity was observed (Cole, Kripke, Gruen, Mullaney, & Gillin, 1992). Sleep diaries asked participants to report on their subjective sleep quality and sleepiness levels and their use of caffeine and medication (see Tables 3 and S1).

3 | RESULTS

3.1 | Alcohol and other drug use

Male and female participants reported similar levels of alcohol consumption prior to detox admission, with the average consumption in the week prior being 128.0 standard drinks for males and 98.6 for females.

3.2 | Sleep and psychological distress prior to detoxification

Global PSQI scores ranged from 5 to 18 with a mean of 11.86 (± 3.59 *SD*). Of the sample, 96.4% reported poor sleep quality (Buysse et al., 1989). Analysis of the sleep component scores revealed that the subscales, sleep quality, disturbances, and daytime dysfunction, were of greatest concern (see Table 1). ESS scores ranged from 0 to 13 with a mean of 6.98 (*SD* ±3.82). Of the sample, 37.9% of participants reported clinically relevant excessive daytime sleepiness. ISI scores ranged from 3 to 26 with a mean of 16.05 (±6.18). Three participants reported no clinically significant insomnia, three participants reported subthreshold insomnia, 11 reported moderately severe insomnia, and three reported severe insomnia.

K-10 scores ranged from 22 to 46 with a mean of 32.59 (*SD* ±5.96). Of the sample, 10.3% of participants had scores within the mild range, 20.7% in the moderate range, and 69.0% in the severe range.

Significant correlations were identified between psychological distress (K-10) and Global Sleep Quality (PSQI) scores (r = .433, R^2 = .187, p < .05) and between psychological distress (K-10) and insomnia (ISI) scores (r = .536, R^2 = .287, p < .05; see Table 2). ISI data indicated that problems consolidating sleep periods were more common than problems associated with sleep latency. A significant relationship was also found between ISI and PSQI scores (r = .707, R^2 = .500, p < .01).

The correlation between previous alcohol consumption and total PSQI score was found to be nonsignificant, although a correlation between alcohol consumption and PSQI component scores revealed a significant association between standard drink consumption and sleep duration (r = .405, p < .05), suggesting that this component of sleep quality may be associated with previous consumption.

TABLE 1 Mean component scores for the Pittsburgh Sleep Quality Index (PSQI) prior to detoxification

PSQI Component	Mean ± Std. Dev
Subjective sleep quality	1.89 ± 0.79
Sleep disturbances	2.21 ± 0.63
Daytime dysfunction	2.19 ± 0.72
Sleep latency	1.61 ± 1.07
Sleep duration	1.04 ± 1.20
Habitual sleep efficiency	1.54 ± 1.29
Use of sleeping medication	1.43 ± 1.35

Note. n = 28.

TABLE 2 Correlation coefficients between psychological distress and sleep outcomes

	K-10	PSQI	ESS	ISI
K-10	1	0.433* (n = 28)	0.227 (n = 29)	0.536* (n = 20)
PSQI		1	−0.269 (n = 28)	0.707**(n = 19)
ESS			1	−0.272 (n = 20)
ISI				1

Note. PSQI = Pittsburgh Sleep Quality Index; ESS = Epworth Sleepiness Scale; ISI, Insomnia Severity Index.

*p < .05.

**p < .01.

3.3 | Sleep during detoxification

Twenty-two participants completed the actigraphy protocol. Mean summary actigraphy results are provided in Table 3. There were no significant correlations between any of these actigraphy parameters and gender, age, or alcohol consumption prior to study admission (all p > .05, data ns), however, there was a significant positive association between participants' self-reported sleep quality and sleep fragmentation measured via actigraphy.

A significant relationship was also identified between alcohol consumption prior to study entry and total sleep time over the last 2 days of detox (r = −.752, R^2 = .566, p < .01). Those who consumed a greater average number of standard drinks per week were found to have a significantly lower total sleep time.

In addition, we examined sleep diary data for associations between sleep quality during the first 3 days of detoxification and self-reported use of caffeine and benzodiazepines, given that (a) withdrawal symptoms typically peak during this period (Kosten & O'Connor, 2003), and (b) previous studies in alcohol detoxification have considered these drugs (Lahti et al., 2011). No significant associations were found (p > .05), using either binary drug use variables (used vs. not used) or a count on the number of times these substances were used.

4 | DISCUSSION

The present pilot study examined sleep and psychological distress in participants prior to and during their admission to an acute residential detoxification service. Poor sleep quality and insomnia were common complaints prior to admission, with 96.4% of participants scoring >5 on the PSQI and 74.8% reporting mild to severe insomnia symptoms. PSQI subscale data revealed the most disrupted sleep components were sleep disturbances, daytime dysfunction, and sleep quality. ISI results indicated problems staying asleep were more prevalent in this population than difficulties falling asleep or problems waking up too early. All participants scored >20 on the K-10 indicating a significant likelihood of anxiety and/or depression. However, it is important to note that alcohol has a depressogenic effect, which may account for the high proportion of elevated scores (Kosten & O'Connor, 2003). In addition, 37.9% scored >10 on the ESS indicating that a proportion of clients were experiencing high levels of daytime sleepiness. This is particularly important considering the negative consequences associated with daytime dysfunction, including falling asleep while driving (Ftouni et al., 2013; Reyner & Horne, 1998), and is consistent with previous research demonstrating that heavy alcohol consumption is associated with next day performance decrements (Rohsenow et al., 2010, van Schrojenstein Lantman, Roth, et al., 2017).

The high severity of poor sleep reported by clients in this study may be a consequence of their previous alcohol consumption (Feige et al., 2006; Stein & Friedmann, 2006) and/or previous anxiety or depression (Nutt, Wilson, & Paterson, 2008). Alternatively, the

TABLE 3 Summary actigraphy results and relationship with self-reported sleep quality

Measure	Mean (*SD*)	Range	Relationship with sleep quality
Total sleep time (min)	440.64 (59.28)	337.30–586.33	0.004
Sleep efficiency (%)	85.43 (4.51)	75.94–91.15	−0.265
WASO (min)	25.09 (21.16)	7.86–89.40	0.048
Onset to sleep latency (min)	11.73 (10.41)	0.00–43.90	−0.024
Sleep fragmentation	30.31 (9.48)	13.12–49.23	0.450*
Self-reported sleep quality[a]	3.25 (0.75)	2.29–5.00	1

Note. WASO = wake after sleep onset.

*$p < .05$, $n = 22$.

[a]Assessed on a 5-point Likert-type scale: 1 = *very good*, 2 = *good*, 3 = *average*, 4 = *poor*, and 5 = *very poor*.

psychological distress may be a result of sleep problems experienced prior to detoxification (Institute of Medicine (US) Committee on Sleep Medicine and Research, 2006). Future studies should examine how the relationships between sleep and psychological distress change through phases of withdrawal and treatment in dependent populations, to determine whether there are patterns in this relationship that confer added vulnerability or resilience to future relapse.

Sleep disturbances and sleep latency have previously been shown to be affected parameters among those dependent on alcohol in both nontreatment seekers and treatment seekers, respectively (Foster & Peters, 1999; Miller, DiBello, Lust, Carey, & Carey, 2016; Ogeil, Phillips, Rajaratnam, & Broadbear, 2015). This suggests that the analysis of specific components of sleep is useful in identifying sleep complaints following both drug use and withdrawal. These previous studies also identified sleep latency as one of the highest scoring PSQI components disturbed following alcohol use, which was not observed in this study. This may reflect a "rebound" effect given that consumption of alcohol had ceased as participants entered treatment, as opposed to the community sample where nontreatment seekers were examined (Ogeil et al., 2015), who were likely to be still drinking. Alternatively, the components of sleep that are disturbed may change depending on when they are assessed in the relative course of treatment. In the present study, the questionnaire values assessed sleep at admission, whereas the diary and the actigraphy values examined sleep during acute withdrawal. Other studies have typically administered questionnaires to outpatients (Foster & Peters, 1999), as well as those who had previously experienced an alcohol-related hangover (van Schrojenstein Lantman, Roth, et al., 2017).

Using actigraphy scoring guidelines consistent with Natale, Plazzi, and Martoni (2009), we analysed the proportion of participants who scored above the threshold for each outcome parameter measured. More than a third of participants scored above the threshold for WASO and sleep latency, indicative of insomnia. Every participant recorded an average sleep efficiency below the recommended value of 92%. These data strongly suggest that alcohol dependent populations have significant problems with disturbed sleep during acute withdrawal. Previous work using actigraphy to examine the sleep of nondependent participants obtained average values for sleep efficiency at 94.18%, an average WASO of 18.35 min and an average latency of 9.34 min (Natale et al., 2009). These values indicate that sleep during acute alcohol withdrawal in this population is below average for all three of these sleep parameters. Although the values for WASO and sleep efficiency reflect disturbed sleep (Natale et al., 2009), the fragmentation index is slightly elevated above what is considered good sleep in a healthy population (<30), but below levels considered abnormally high (Lahti et al., 2011). In addition, there was a significant relationship between sleep fragmentation and subjective quality, which may be of clinical relevance given that greater sleep fragmentation was associated with poorer subjective sleep quality. Future research should assess whether (a) there are changes in sleep fragmentation which persist over time following detoxification; (b) these changes in sleep fragmentation continue to be associated with self-reported sleep quality; and (iii) there are relationships between these variables and subsequent relapse propensity (Brower, 2003).

Use of caffeine and sedating benzodiazepines are common during alcohol detoxification (Lahti et al., 2011), potentially complicating outcomes given that both drugs may affect sleep (Drake, Roehrs, Shambroom, & Roth, 2013; Drummer, 2002). Although benzodiazepine use has previously been associated with no significant change in sleep measures in patients withdrawing from alcohol when added as a covariate (Lahti et al., 2011), in the same study, caffeine did affect sleep. A recent systematic review summarises the effects of caffeine on sleep noting that the drug affects sleep quality measures (Clark & Landolt, 2017). Although we did not find significant differences in sleep quality by use of either substance, individual differences in response to caffeine dose, administration time, and tolerance may affect these outcomes (Clark & Landolt, 2017; Smith, 2002). In addition, Ferré and O'Brien (2011) reported that caffeine use may be of benefit during alcohol withdrawal, regulating adenosine receptors, which are typically downregulated following chronic alcohol use. Future studies should examine this relationship further, given that caffeine also has positive mood effects, which are likely important given the associations between mood and sleep disturbance.

Findings from this study support the use of specific interventions to address sleep problems, given that these issues are not likely to resolve on their own (Brower, 2003). Although future research is needed to assess the effectiveness of any intervention, our results indicate that targets should include reducing the number of disturbances experienced throughout the night, and increasing alertness throughout the day in those reporting daytime sleepiness may be most appropriate (Arnedt et al., 2007). Additionally, the relationship between the level of alcohol consumption and sleep duration suggests that severely dependent users may benefit from interventions that aim to increase total sleep time during the withdrawal period. Considering

the prevalence of psychological distress within this sample, interventions simultaneously targeting sleep, daytime sleepiness, and anxiety and depressive symptoms underlying psychological distress simultaneously may be more effective than sleep treatment alone. Cognitive-behavioural therapy (in combination with good sleep hygiene) appears to be the most promising treatment in this regard and has previously showed promising results (Currie, Clark, Hodgins, & El-Guebaly, 2004). Melatonin also seems to be a potential candidate given that alcohol may affect the circadian clock (Hasler, Smith, Cousins, & Bootzin, 2012), and melatonin has shown promise as a treatment for both insomnia and mood disturbances including depression (Dalton, Rotondi, Levitan, Kennedy, & Brown, 2000; Wade et al., 2011).

4.1 | Limitations

Data were not available for all participants given issues with compliance. When considered together, however, the findings from both the objective actigraphy data and the subjective questionnaire and diary data suggest that sleep issues are significant in this population. In addition, we relied on subjective recall of participants' alcohol and other drug use. Although we reported a trend in the relationship between alcohol consumption and total PSQI score in the previous week, future studies may utilise timeline follow back methods over longer periods to further examine these issues (Pedersen, Grow, Duncan, Neighbors, & Larimer, 2012) and also seek permission to examine medical records of patients to provide greater information on the dose and timing of administration of other medications which may affect sleep.

In contrast to previous studies, we did not find self-reported sleep latency to be significantly disturbed in the period prior to detoxification (Brower, 2001), however, this may reflect individual drinking history, given that alcohol consumption just prior to sleep may decrease sleep latency onset. Additionally, sleep problems during detoxification may have been masked by the prescription of medications including benzodiazepines, which are used to treat alcohol withdrawal symptoms and insomnia. Although we were not able to examine sleep measures in the absence of coadministered medication (see Table S1), our study provides data from a residential detoxification service, demonstrating that alcohol affects sleep parameters both prior to and during entry to detoxification. This may also suggest that the timing of administration of these instruments is sensitive to the period of use or withdrawal and should be considered further given that sleep-related issues are unlikely to dissipate but may manifest differently during the withdrawal period.

4.2 | Conclusion

Sleep problems were common among alcohol-dependent participants both prior to and during acute alcohol withdrawal. Poor sleep was strongly associated with psychological distress, reinforcing the strong links between these behavioural outcomes. Subjectively, the most disturbed facets of sleep in those entering detoxification for alcohol were daytime dysfunction, sleep disturbances, and sleep quality, and objective methods indicated that during acute withdrawal poor sleep efficiency was common. As different facets of sleep may be disturbed across the differing stages of treatment for alcohol dependence, it is likely that tailored intervention approaches may be required to address specific sleep deficits.

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CONFLICTS OF INTEREST

Dan Lubman has received speaking honoraria from AstraZeneca, Janssen, Servier, and Lundbeck and has provided consultancy advice to Lundbeck and Indivior. All other authors report no conflicts.

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SUPPORTING INFORMATION

Additional Supporting Information may be found online in the supporting information tab for this article.

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