

RESEARCH ARTICLE

The impact of alcohol hangover symptoms on cognitive and physical functioning, and mood

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Abstract

Hangover research often records the presence and severity of symptoms experienced the day after heavy alcohol consumption. However, usually no information is gathered on the impact of experiencing these symptoms on mood, cognition, and physical activities.

An online survey was held among Dutch students, aged 18–30 years, who recently had a hangover. Overall hangover severity (i.e., a single 1-item rating) and the severity of 22 individual symptoms were rated on an 11-point scale ranging from 0 (*absent*) to 10 (*extreme*). In addition, for each symptom, participants were asked to rate their respective negative impact on (a) cognitive functioning, (b) physical functioning, and (c) mood, on a 6-point Likert scale ranging from 0 (*no impact*) to 5 (*extreme*).

$N = 1837$ subjects completed the survey. The mean (SD) overall (1-item) hangover severity score was 6.1 (1.9). Sleepiness, being tired, thirst, and concentration problems were the most frequently reported hangover symptoms. These symptoms also reached the highest severity scores (ranging from 6.3 to 7.0). The 4 symptoms with the biggest combined impact on mood, and cognitive and physical functioning were being tired, sleepiness, headache, and concentration problems. In conclusion, whereas severity and impact scores usually correspond well, some frequently reported symptoms with moderate to high severity scores had little impact on mood, and cognitive and physical functioning (i.e., reduced appetite, regret, and thirst).

KEYWORDS

alcohol, hangover, impact, severity, symptoms

1 | INTRODUCTION

The alcohol hangover refers to the combination of mental and physical symptoms, experienced the day after a single episode of heavy drinking, starting when blood alcohol concentration approaches zero (Van Schrojenstein Lantman, van de Loo, Mackus, & Verster, 2016). Penning, McKinney, and Verster (2012) systematically investigated the plethora of hangover symptoms that were mentioned in the scientific literature. This listing of symptoms was shown to 1440 Dutch students who rated the incidence and severity of each symptom experienced during their last alcohol hangover. They had the opportunity to add additional symptoms, and the final listing composed of 49 different hangover symptoms. A subsequent factor analysis enabled grouping the reported symptoms

(Penning et al., 2013). Eleven factors were identified, of which “drowsiness” and “cognitive effects” appeared to be the most dominant domains.

Currently, there are three commonly used hangover scales (Penning et al., 2013; Rohsenow et al., 2007; Slutske, Piasecki, & Hunt-Carter, 2003). All scales rate the severity of a number of hangover symptoms, which sum up to an overall hangover severity score. Surprisingly, each scale lists different hangover symptoms. The only three symptoms that are listed by all three scales are fatigue (being tired), thirst, and nausea. The reason for this discrepancy lies in the different ways the scales were developed and, most importantly, the different methodologies that were applied to derive scale items. The inclusion of hangover symptoms was either based on literature (Slutske et al., 2003), survey data (Penning et al., 2013), or

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experimental research (Rohsenow et al., 2007). Interestingly, although most individual items differ, the overall hangover severity sum scores of the three scales correspond very well (Penning et al., 2013). Given the diversity of hangover symptoms across the scales, researchers have also combined the different hangover items from the three scales into a new 22-item scale, assessing them all. In addition, a one-item overall hangover severity score is used to replace the symptom-based sum score (Hogewoning et al., 2016; Van de Loo et al., 2017).

The incidence rates and severity scores of each symptom provide important information on how common symptoms are experienced during hangover, and their magnitude. However, they do not provide any information on the impact of these symptoms on daily functioning or mood. The fact that a symptom is rated as severe does not automatically imply that the effect on cognition and performance are disabling per se, nor that it will affect ones' mood. For example, a mild headache can already have a significant impact on job performance or studying, whereas thirst or dry mouth may be annoying but have little impact of cognitive and physical activities. Up to now, no research has been conducted to identify the relative impact of individual hangover symptoms on daily functioning.

From scientific literature, it is evident that all three domains, that is, cognitive and physical functioning, and mood, may be impaired during the hangover state. Activities that require normal cognitive and psychomotor functioning may be impaired during alcohol hangover (for a review, see Ling, Stephens, & Heffernan, 2010). For example, during the hangover, state managerial skills may be compromised (Streufert et al., 1995), increased errors during surgical procedures have been reported (Dorafshar, O'Boyle, & McCloy, 2002), operating complex power plant machinery was impaired (Rohsenow, Howland, Minsky, & Arnedt, 2006), and a significantly reduced ability to drive a car during hangover has been observed (Verster et al., 2014). Similarly, alcohol hangover may negatively affect behaviors that require physical effort and muscle strength. For example, having a hangover significantly reduced ability to ride a bicycle (Hartung et al., 2015), a significant negative effect on aerobic fitness assessments in rugby players (O'Brien, 1993), and increased the risk of accidents in recreational skiers (Cherpitel, Meyers, & Perrine, 1998).

McKinney (2010) summarized the literature on mood changes during alcohol hangover. The review identified that increased anxiety levels, decrease in alertness, increase in fatigue, lower arousal, physical discomfort, and emotional disturbance were commonly reported mood changes. Frequency and severity of these mood changes was usually assessed using the Profiles of Mood Scale (e.g., Howland et al., 2010), specific scales such as the State-Trait Anxiety Scale (e.g., Finnigan, Schulze, Smallwood, & Helander, 2005), or by incorporating these items as part of hangover severity scales (e.g., Verster, van Duin, Volkerts, Schreuder, & Verbaten, 2003). Again, none of the studies discussed to what extent individual hangover symptoms have a negative impact on mood.

It is important to know *which* hangover symptoms have the most impairing impact on mood, and cognitive and physical functioning. For example, this information is essential for those who aim to develop an effective hangover cure, as new treatments can then specifically target these symptoms. The aim of the current study was to identify those hangover symptoms that have the biggest impact on mood, and cognitive and physical functioning.

2 | METHODS

An online survey was held among Dutch students in December 2016. The survey was designed using www.surveymonkey.com, and advertisements to complete the survey were distributed via www.facebook.com. The advertisement targeted specifically at students (age range 18 to 30 years old), studying in one of the Dutch University cities. Online informed consent was obtained, and participants could win a 100 Euro gift voucher. No formal ethics approval was required for this type of survey research.

The survey took approximately 10 min to complete. Only data from participants who reported having alcohol hangovers were recorded. Demographic data, including age, gender, and weight, were collected. Weekly alcohol consumption was assessed, as well as alcohol consumption the day before they had their latest hangover. Overall hangover severity (i.e., a single one-item rating) and the severity of 22 individual symptoms were rated on an 11-point scale ranging from 0 (*absent*) to 10 (*extreme*; Hogewoning et al., 2016). This way, all 22 hangover symptoms that are listed in the Alcohol Hangover Severity Scale, the Hangover Symptoms Scale, and the Acute Hangover Scale (Penning et al., 2013; Rohsenow et al., 2007; Slutske et al., 2003) were assessed. In addition, for each symptom, participants were asked to rate their respective negative impact on (a) cognitive functioning, (b) physical functioning, and (c) mood. This was done on a 6-point Likert scale ranging from 0 (*no impact*) to 5 (*extreme*). As examples of cognitive functioning, studying, memory, and logical reasoning were mentioned; as examples of physical functioning physical labor, sports, driving, and reaction time were mentioned.

Data were analyzed using SPSS, version 24. Frequency and mean (*SD*) severity was computed for each individual hangover symptom, as well as the mean (*SD*) overall hangover severity score. Mean (*SD*) impact scores were computed for each hangover symptom. For each domain, the impact scores were associated with the overall hangover severity score, using nonparametric correlations (Spearman's rho).

3 | RESULTS

$N = 2564$ subjects participated in this survey. After removing respondents that do not consume alcohol, have no hangovers, have an age outside the 18–30 years old range, those who did not give informed consent, and those that consumed alcohol for more than 12 hr, data from $N = 1837$ subjects who reported on their latest alcohol hangover were used for the statistical analyses. Their mean (*SD*) age was 20.8 (2.3) years old, and 49.6% ($N = 912$) of them were female. On average, they reported consuming 13.6 (10.1) alcoholic drinks per week. The day before their latest hangover, they on average consumed 12.6 (5.5) alcoholic drinks within a mean (*SD*) time period of 5.8 (2.0) hours.

3.1 | Presence and severity of hangover symptoms

The mean (*SD*) overall (one-item) hangover severity score was 6.1 (1.9). The occurrence and severity of individual hangover symptoms is listed in Table 1. In those who experienced individual symptoms, severity scores were on average of moderate magnitude (ranging from 3.3 to 7.0). Sleepiness, being tired, thirst, and concentration problems were the most commonly reported hangover symptoms. These symptoms also reached the highest severity scores (ranging from 6.3 to 7.0).

TABLE 1 Presence and severity of alcohol hangover symptoms

	Reported by (%)	Mean (SD) overall (100%)	Mean (SD) by those reported
Overall hangover severity	100.0	6.1 (1.9)	6.1 (1.9)
Tired	98.3	6.9 (2.3)	7.0 (2.2)
Sleepiness	97.1	6.5 (2.4)	6.7 (2.2)
Thirst	96.0	6.5 (2.6)	6.8 (2.3)
Concentration problems	95.7	6.0 (2.6)	6.3 (2.3)
Headache	92.8	5.3 (2.8)	5.7 (2.4)
Nausea	88.0	4.9 (3.1)	5.6 (2.6)
Apathy	82.3	4.8 (3.2)	5.8 (2.5)
Weakness	86.7	4.7 (2.9)	5.4 (2.4)
Clumsy	80.8	4.1 (3.0)	5.1 (2.4)
Reduced appetite	73.0	4.1 (3.3)	5.6 (2.5)
Regret	71.1	3.3 (3.1)	4.6 (2.7)
Dizziness	68.5	3.0 (2.9)	4.4 (2.5)
Sweating	63.2	2.8 (2.9)	4.5 (2.5)
Stomach pain	62.0	2.8 (2.9)	4.5 (2.5)
Sensitivity to light	59.4	2.5 (2.8)	4.2 (2.4)
Confusion	54.7	2.3 (2.8)	4.3 (2.4)
Heart racing	51.6	2.2 (2.8)	4.3 (2.5)
Shivering	50.2	2.2 (2.8)	4.3 (2.6)
Heart pounding	42.5	1.7 (2.6)	4.1 (2.4)
Vomiting	28.2	1.5 (2.9)	5.3 (3.2)
Depression	34.2	1.3 (2.3)	3.9 (2.5)
Anxiety	22.6	0.7 (1.8)	3.3 (2.4)

Although some symptoms were reported by less than half of the sample, they did have moderate severity scores (e.g., vomiting). The least commonly reported and least severe symptoms are feelings of anxiety and depression, with severity scores of 3.9 and 3.3, respectively.

A regression analysis was conducted to determine which combination of individual hangover symptoms significantly predicted the overall (one-item) hangover severity score. The analysis revealed a significant model ($R^2 = 52.9\%$) and showed that overall hangover severity is significantly predicted by nausea (30.9%) and headache (12.3%). Other symptoms that significantly contributed to the model were weakness, concentration problems, vomiting, regret, being tired, heart racing, and apathy, which together accounted for a predictive validity of 9.1%.

3.2 | Impact on mood, cognitive functioning, and physical activities

For all symptoms, significant correlations ($p < .05$) were found between the symptom severity scores and their corresponding impact scores. Table 2 summarizes to what extent individual symptoms have a negative impact on cognitive and physical functioning, and mood. In addition, a sum score is given of the three domains to represent an overall impact score. For all three domains, being tired, sleepiness, and headache were reported as having the biggest negative impact, followed by nausea and concentration problems. Sometimes, symptoms differentially impact the three domains. For example, for concentration problems, the impact scores on cognitive functioning are much bigger than the impact scores on mood and physical functioning. Also

TABLE 2 Negative impact of hangover symptoms on cognitive functioning, physical functioning, and mood

	Overall impact	Cognitive functioning	Physical functioning	Mood
Tired ^{a,c}	8.0 (4.1)	2.8 (1.7)	2.6 (1.7)	2.7 (1.6)
Sleepiness ^{a,c}	7.6 (4.2)	2.7 (1.7)	2.5 (1.7)	2.4 (1.6)
Headache ^{a,b,c}	7.5 (4.5)	2.7 (1.8)	2.3 (1.7)	2.4 (1.7)
Concentration problems ^{a,b,c}	6.6 (4.1)	3.1 (1.8)	1.8 (1.7)	1.7 (1.6)
Nausea ^{a,c}	6.0 (5.0)	1.9 (1.8)	2.0 (1.9)	2.2 (1.9)
Apathy ^{b,c}	4.8 (4.5)	1.6 (1.8)	1.4 (1.7)	1.8 (1.7)
Weakness ^{b,c}	4.6 (4.3)	1.4 (1.6)	1.8 (1.8)	1.5 (1.5)
Clumsy ^{a,b,c}	3.7 (3.8)	1.1 (1.4)	1.6 (1.7)	1.0 (1.3)
Thirst ^{a,c}	3.5 (3.7)	1.0 (1.4)	1.2 (1.5)	1.4 (1.5)
Dizziness ^{a,b,c}	3.3 (4.2)	1.1 (1.5)	1.3 (1.7)	1.0 (1.4)
Stomach pain ^{a,b,c}	3.3 (4.1)	1.0 (1.4)	1.1 (1.5)	1.2 (1.6)
Vomiting ^{a,c}	2.9 (4.7)	0.8 (1.6)	1.0 (1.7)	1.0 (1.8)
Reduced appetite ^{a,b,c}	2.7 (3.5)	0.8 (1.2)	0.9 (1.4)	1.1 (1.4)
Confusion ^{a,b,c}	2.6 (3.6)	1.0 (1.5)	0.8 (1.3)	0.8 (1.3)
Sensitivity to light	2.4 (3.6)	0.8 (1.3)	0.8 (1.3)	0.8 (1.3)
Regret ^{a,b,c}	2.2 (3.5)	0.7 (1.3)	0.5 (1.1)	1.1 (1.6)
Depression ^{a,b,c}	2.1 (3.7)	0.8 (1.4)	0.5 (1.1)	0.9 (1.6)
Sweating ^{a,c}	1.6 (2.8)	0.5 (1.0)	0.6 (1.2)	0.6 (1.1)
Shivering ^{b,c}	1.6 (2.7)	0.5 (1.1)	0.6 (1.2)	0.5 (1.1)
Heart pounding ^{b,c}	1.4 (2.9)	0.4 (1.0)	0.6 (1.2)	0.5 (1.1)
Heart racing ^{b,c}	1.4 (2.9)	0.4 (1.0)	0.6 (1.2)	0.5 (1.0)
Anxiety ^{b,c}	1.2 (2.8)	0.5 (1.1)	0.4 (1.0)	0.5 (1.2)

Mean (Standard Deviation) are shown. Scores range from 0 (*absent*) to 5 (*extreme*). The overall impact score is the sum of the scores on cognitive functioning, physical functioning, and mood.

^aSignificant difference ($p < .05$) between impact scores of cognitive functioning and mood.

^bSignificant difference ($p < .05$) between impact scores of physical functioning and mood.

^cSignificant difference ($p < .05$) between impact scores of cognitive and physical functioning.

of interest, frequently reported symptoms with high severity scores such as thirst and reduced appetite show to have little impact on the three domains.

4 | DISCUSSION

The four most frequently reported hangover symptoms were being tired, sleepiness, thirst, and concentration problems. All of these symptoms were reported by at least 95% of the participants. These were also the hangover symptoms that had the highest severity scores. Although symptoms that are frequently experienced usually also have high severity scores, this is not always the case. For example, vomiting was reported only by a minority 28.2% of participants. The severity score by those who had to vomit was however relatively high (5.3).

The four symptoms with the biggest impact on mood, and cognitive and physical functioning were being tired, sleepiness, headache, followed by concentration problems. For each domain, being tired, sleepiness, and headache had the most impact, respectively, with the

exception of concentration problems that had the highest impact on cognitive functioning. The current data reveal that those symptoms who have higher severity scores often also have a bigger impact on mood, and cognitive and physical functioning, and vice versa. For example, anxiety and depression have low impact scores on the three domains, which can be explained by their low incidence and low severity scores. Alternatively, concentration problems and headache are commonly reported hangover symptoms with high severity scores and have a high impact on the three domains.

There are however exceptions to this general view. For example, reduced appetite, regret, and thirst are frequently reported hangover symptom with moderate to high severity scores. Their impact on mood, and cognitive and physical functioning is however very limited. It is thus unlikely that drinking water will help reducing overall hangover severity (Köse, van de Loo, Fernstrand, Garssen, & Verster, 2015). Thirst can easily be alleviated by drinking water, and it has been shown that water consumption can have a positive effect on sleep and mood (Pross et al., 2014). However, the regression analyses presented in this paper revealed that thirst and reduced appetite were no significant predictors of overall hangover severity. In a recent study, drinkers who recently experienced a hangover were asked to define the concept of alcohol hangover (Van Schrojenstein Lantman et al., 2016). The participants most frequently reported the combination of nausea, headache, being tired, and apathy. Although not specifically assessed, it may be assumed that a combination of high severity and high impact scores of these symptoms have led to their selection. Thirst, regret, and reduced appetite were not commonly used to describe their hangover state, illustrating that despite their presence and severity, these symptoms are not regarded as core symptoms of the alcohol hangover. Their low impact on mood, and cognitive and physical functioning may have contributed to this.

Finally, some symptoms may have a big impact on one specific domain but not others. For example, cognitive problems had a bigger impact on the domain cognitive functioning, whereas clumsiness had a bigger impact on physical functioning. In general, however, for individual symptoms, their impact scores were very consistent across the three domains.

The current study has the common limitations that are true for all survey research. As data were collected retrospectively, recall bias may have influenced the results. The time between completing the survey and the participants' latest hangover may have varied between participants. On the other hand, in previous studies, most drinkers reported having at least one hangover per month (e.g., Hogewoning et al., 2016) suggesting that on average, this time period is relatively short. Also, the heavy drinking occasion preceding a hangover is likely to stand out relative to regular drinking occasions, making it more likely that drinkers will remember more details concerning this particular drinking occasion.

The symptoms with most impact on cognitive and physical functioning and mood were being tired, sleepiness, headache, concentration problems, and nausea. The implications of our findings for drug development are clear. Development of new hangover treatments should aim at combating especially these symptoms, as these showed to be much more disabling than, for example, dehydration-related hangover symptoms such as thirst. Future research should examine

the specific causes of the highest impact symptoms. For example, it can be examined whether the severity of these symptoms corresponds to cytokine concentrations in blood or saliva. This information will yield essential knowledge, as it will guide drug development towards to origins of the occurrence of these symptoms.

In conclusion, the four symptoms with the biggest impact on mood, and cognitive and physical functioning were being tired, sleepiness, headache, and concentration problems. In addition to being most frequently reported and having high severity scores, their impact scores were highest across the three domains. Whereas severity and impact scores usually correspond well, some frequently reported symptoms with moderate to high severity scores had little impact on mood, and cognitive and physical functioning (i.e., reduced appetite, regret, and thirst).

Declaration of interest

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