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ScienceDirect
Addictive Behaviors 32 (2007) 1314–1320
ADDICTIVE BEHAVIORS

Short communication

The Acute Hangover Scale: A new measure of immediate hangover symptoms

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Abstract

Purpose: No psychometrically established measure of acute hangover symptoms is published and available to use in experimental investigations. The present investigation combined data across three studies of residual alcohol effects to establish the properties of a new Acute Hangover Scale (AHS) based on symptoms supported in previous lab studies.
Methods: Professional mariners from a Swedish maritime academy ($n=54$) and young adult students/recent graduates of urban U.S. universities ($n=135$) participated in one of three within-subjects' studies of residual effects of heavy drinking ($M=0.114$ g% breath alcohol concentration [BrAC]). All drank placebo one evening and alcoholic drinks another evening followed by an 8-h sleep period before completing the AHS 10–20 min after awakening.
Results: The AHS showed excellent internal consistency reliability the morning after alcohol. The AHS mean score and each item were significantly affected by beverage but not demographics or typical drinking, supporting validity.
Conclusions: The AHS is a reliable and valid instrument for assessing acute hangover symptoms in experimental investigations of residual alcohol effects.

Keywords: Hangover; Residual alcohol effects; Psychometric; Assessment

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doi:10.1016/j.addbeh.2006.10.001

1. Introduction

Residual alcohol effects are all effects that occur when BrAC is falling after an episode of heavy drinking while hangover refers to the set of subjective symptoms that peaks about when BrAC reaches 0 g%. Residual alcohol effects on behavior are of particular interest to the extent that they affect safety-sensitive occupational performance (Howland, Almeida, Rohsenow, Minsky, & Greece, in press) but the extent to which this impairment correlates with or results from hangover symptoms is not known, partly due to the lack of any established measure of acute hangover. In order to conduct experimental investigations of determinants and behavioral correlates of hangover, a reliable and valid measure of hangover symptoms is needed for use in acute situations. Early experimental investigations of hangover using individual signs and symptoms without scale development validated certain subjective symptoms whereas objective signs of hangover were not significantly increased (Chapman, 1970; Seppala, Leino, Linnoila, Huttumen, & Ylikahri, 1976; Ylikahri, Huttumen, Eriksson, & Nikkila, 1974).

Survey instruments (e.g., Slutske, Piasecki, & Hunt-Carter, 2003) were not developed for use in acute situations and the items were not necessarily derived from experimental investigations. Some experiments have used items assessing withdrawal rather than hangover (e.g., McCaul, Turkkan, Svikis, & Bigelow, 1991; Span & Earlywine, 1999) or hangover symptoms plus cognitive reactions such as guilt (e.g., Span & Earlywine, 1999) or hangover symptoms plus a withdrawal sign invalid for hangover (Kruisselbrink, Martin, Megeney, Fowles, & Murphy, 2006) or gave no information about item selection or validity (e.g., Finnigan, Schulze, Smallwood, & Helander, 2005). The present study developed an Acute Hangover Scale (AHS) based on symptoms supported in experimental investigations of hangover, with psychometric determination of items to retain, reliability and validity. While preliminary results were reported on a smaller separate set of maritime academy cadets (Rohsenow, Howland, Minsky, & Arnedt, 2006), analyses in this larger sample with a broad range of age and experience will provide more stable estimates of psychometric properties. A related aim was to explore which specific items increased significantly as a function of residual effects of alcohol versus placebo since no other study published statistical analyses at the specific symptom level except a study using only five people and a much lower BrAC (0.06 g%; Roehrs, Yoon, & Roth, 1991).

2. Methods

2.1. Participants and sites

Data from three studies at two sites were combined. Site 1 included 54 professional mariner deck officers fluent in English at the Kalmar Maritime Academy in Sweden; Site 2 included 135 young adults in or recently graduated from universities around Boston, MA (two studies). Volunteers reported no history of alcohol or drug problems, no exclusionary medical conditions or medications, at least occasionally drinking ≥ five alcoholic drinks in one day if male or ≥ four if female, and were not pregnant or nursing.

2.2. Study designs and methods

All three studies used a double-blind placebo-controlled two-group (alcohol vs. placebo) within-subjects design in which participants drank alcohol on one night and placebo on the other night

Table 1
Participant characteristics by population type

	Professional mariners ($n=54$)	University students/ recent graduates ($n=135$)	Total ($n=189$)
Sex*			
Male	53 (98.2%)	58 (43.0%)	111 (58.7%)
Female	1 (1.8%)	77 (57.0%)	78 (41.3%)
Age*			
Mean±SD	34.1±8.4	23.5±2.6	26.5±6.9
Range	22–57	21–31	21–57
Race*			
White	54 (100.0%)	108 (80.0%)	162 (85.7%)
Black/African-American	0 (0.0%)	3 (2.2%)	3 (1.6%)
Asian	0 (0.0%)	8 (5.9%)	8 (4.2%)
Native Hawaiian, Pacific Islander	0 (0.0%)	5 (3.7%)	5 (2.7%)
American Indian	0 (0.0%)	6 (4.4%)	6 (3.2%)
Other or mixed	0 (0.0%)	5 (3.8%)	5 (2.6%)
How often had beer, wine or liquor in past 30 days*			
Nearly everyday (5 or 6 days per week)	2 (3.7%)	11 (8.2%)	13 (6.9%)
Two to four days per week	27 (50.0%)	89 (65.9%)	116 (61.4%)
Once a week	13 (24.1%)	25 (18.5%)	38 (20.1%)
Three days a month	8 (14.8%)	7 (5.2%)	15 (7.9%)
One or two days a month	3 (5.6%)	3 (2.2%)	6 (3.2%)
I did not drink	1 (1.8%)	0 (0.0%)	1 (0.5%)
In the past 30 days, on a typical day that you drank, how much did you drink in one day			
1–2 drinks	20 (37.7%)	39 (28.9%)	59 (31.4%)
3–4 drinks	15 (28.3%)	60 (44.4%)	75 (40.0%)
5–6 drinks	11 (20.8%)	24 (17.8%)	35 (18.6%)
7 drinks or more	7 (13.2%)	12 (8.9%)	19 (10.1%)
Maximum BrAC			
Mean±SD	0.115±0.015	0.114±0.014	0.114±0.014
Range	0.091–0.155	0.090–0.162	0.090–0.162

*$p<0.05$.

(counterbalanced order) with order randomization stratified by gender. The beverages were given in a quantity estimated to yield 0.10 g% BrAC (1.2 g/kg body weight for men and 1.0 g/kg for women) or an equivalent amount of matched placebo. Alcohol beverages for Study 1 and Study 3 ($n=49$) were high alcohol (7.2%) beer and for Study 2 were 100 proof vodka ($n=38$) or 101 proof bourbon ($n=48$, by random assignment) mixed with chilled caffeine-free cola. Matched placebos were nonalcoholic beer or caffeine-free cola plus de-carbonated tonic water in amount equivalent to the alcohol with a few drops of vodka or bourbon floated. If participants receiving alcohol did not reach the target BrAC 15 min after the last beverage, an additional amount of alcoholic beverage was given based on the

ratio of obtained/target BrAC, with extra placebo provided to the same number of placebo participants.

Groups of four to five participated 1–7 days apart. They were told not to have alcohol within the prior 24 h or food or beverage within the prior 3 (Site 1) or 4 h (Site 2) and were rescheduled if noncompliant. Beverage administration started at 7:30 p.m. (Site 1) or 8:45 p.m. (Site 2) and ended 60–90 min later. Participants were allowed 8 h for sleeping and an hour for washing and breakfast the next morning before performance assessments. They completed the hangover measure 10–20 min after being awakened because hangover is most detectable before 10 a.m. (Ylikahri et al., 1974).

2.3. Measures

Recent drinking was estimated using two items for the past 30 days: about how often they had any beer, wine or liquor (rated from 1 "once a day" to 7 "did not drink" with each point anchored) and about how much they had to drink on a typical day that they drank (one drink defined as 12 oz of beer or wine cooler, 4 oz of wine or 1 oz of liquor), with eight choices: 1 to 7 drinks and "8 or more drinks".

The nine AHS items included all the validated items from Chapman (1970; also supported by Ylikahri et al., 1974) except trouble sleeping (not an experience "right now") and general malaise (not a term used in lay language but replaced by "hangover"). The answer format used the 0–7 scale of Chapman (1970) with Roehrs et al.'s (1991) four anchors: None (0), Mild (1), Moderate (4) and Incapacitating (7). The general instruction was "Please rate how you feel right now on the following rating scales".

2.4. Data analysis approach

First, Cronbach's alpha was used for reliability and to determine whether removal of any item would improve the reliability. Second, validity was investigated by comparing the AHS total score and items between the two beverage conditions using paired *t*-tests. Effect sizes are reported in terms of *d* (a medium effect is $d=0.50$ to 0.79; a large effect is ≥ 0.80). Third, discriminant validity tested the predicted non-relationship of AHS score to age, race, gender, professional status, and quantity and frequency of typical drinking (since only acute drinking should determine hangover). (Correlations with obtained BrAC were not considered a valid test due to highly restricted range.)

3. Results

3.1. Participant characteristics, sleep time and maximum BrAC

Participant characteristics are displayed in Table 1 by population type. The professional mariners were significantly more likely to be male ($\chi^2=48.46$, $df=1$, $p<0.0001$), were older ($t(57.3)=9.12$, $p<0.0001$, *df* adjusted for unequal variances), more were White ($\chi^2=12.60$, $df=1$, $p<0.001$), and they drank more frequently ($\chi^2=11.65$, $df=5$, $p<0.04$).

3.2. Reliabilities

The AHS had a standardized Cronbach's $\alpha=0.84$ after alcohol administration. The best item–total correlations were for "hangover", "dizziness or faintness" and "nausea" (rs=0.66–0.67) and the lowest

Table 2
AHS total and items on the morning after alcohol intoxication vs. placebo

	Morning after alcohol, $M \pm$S.D.	Morning after placebo, $M \pm$S.D.	Paired $t(df=187)$	Effect size, d
Hangover	1.8±1.5	0.04±0.19	15.39*	1.98
Thirsty	3.5±1.6	1.9±1.5	13.26*	1.06
Tired	3.3±1.5	2.5±1.6	7.33*	0.55
Headache	1.2±1.6	0.2±0.6	9.24*	1.01
Dizziness, faintness	0.7±1.1	0.1±0.4	6.82*	0.73
Loss of appetite	0.9±1.4	0.3±0.8	5.18*	0.49
Stomach ache	0.5±1.1	0.1±0.4	4.64*	0.48
Nausea	0.5±1.3	0.1±0.4	4.35*	0.48
Heart racing	0.3±0.8	0.0±0.2	4.45*	0.46
AHS total (mean) score	1.4±0.9	0.6±0.4	13.92*	1.29

*$p<0.0001$.

was for "thirsty" ($r=0.39$). No item's removal increased reliability. Excluding the item "hangover" (per Slutske et al., 2003) lowered reliability to $\alpha=0.81$ so it was retained. Therefore, a mean score of all AHS items was computed.

3.3. Validity

The paired t-tests for AHS mean score and each item were significant (Table 2). Beverage condition had a very large effect size for AHS mean score. Among the individual items, the "hangover" item had the largest statistical effect size, two other items ("thirsty" and "headache") had large statistical effect sizes, two ("tired" and "dizziness or faintness") had medium effect sizes, and four symptoms had effect sizes just below the medium range. Only "thirsty" and "tired" approached moderate severity with the rest in the mild range.

Discriminant validity was supported by nonsignificant relationships of the AHS with age ($r=-0.18$), race (White vs. non-White; $t(186)=1.85$), gender ($t(186)=0.64$), professional mariners vs. university participants, covarying age since groups differed in age ($F(2,185)=1.80$), mean drinking frequency ($r=0.30$), or drinking quantity on a typical day ($r=-0.07$), all ps>0.20.

4. Discussion

The AHS, developed for use in assessing hangover symptoms acutely in laboratory investigations of hangover, was found to be highly reliable and valid, consistent with the smaller analysis previously conducted on a separate limited set of participants (Rohsenow et al., 2006). Only symptoms previously empirically supported in laboratory work on hangover were included. The AHS total (mean) score is valid as it was significantly affected by previous evening's consumption of alcohol versus placebo yet was not affected by demographic variables or recent drinking history. Even though the amount of alcohol administered was probably much lower than many people drink when they report hangovers, even this relatively mild hangover was detectable, consistent with BrAC levels producing increased hangover symptoms in studies by others (e.g., Chapman, 1970; Kruisselbrink et al., 2006).

The contribution of specific items was also of interest for understanding the nature of symptoms most relevant to hangover. Probably because AHS items were selected based on previous laboratory

work, all items were ones that were significantly affected by alcohol. The items "Thirsty" and "Tired" had the highest values, the only items scored in the "Moderate" range the morning after drinking alcohol. However, these items also were highest the morning after placebo administration so inspecting values only after alcohol may be misleading; people may be tired and thirsty at that time in the morning anyway. The largest effect sizes as a function of alcohol ingestion were for "hangover", "thirsty", and "headache", in that order. The other items all had medium or just below medium statistical effect sizes. Controversy exists over whether the item "hangover" should be included (Slutske et al., 2003), because it includes a direct attribution to residual alcohol effects. It was selected in part to best reflect the item "malaise" (from Chapman, 1970) in plainer language and partly to investigate the degree to which people perceived themselves as hung over after this amount of alcohol. This item had the largest effect size as a function of alcohol administration and the highest item–total correlation with all other items, so it may be worth retaining. While removing this item would lower the reliability of the scale somewhat, the reliability is excellent without it, so investigators have the option of scoring this instrument either way.

Limitations of this study included alcohol administration only to about 0.12 g%, and limited populations. Future studies can increase the diversity of the participants and investigate the effects of higher BrACs. The primary strength of this study was that it studied hangover prospectively in a double-blind controlled design and therefore avoided biases that occur in retrospective studies (e.g., recall problems, self-serving attributions) or cross-sectional designs (e.g., self-selection bias), and that it started with symptoms that had already shown some empirical foundation. Future work can use this instrument in laboratory studies to investigate a number of theoretical questions about variables affecting intensity of hangover.

Acknowledgements

This study was supported by the Harvard Injury Control Research Center with funding from the Centers for Disease Control and Prevention (R49 CCR115279) and from the National Institute on Alcohol Abuse and Alcoholism (RO1 AA12087) to the Boston University School of Public Health, and by the General Clinical Research Center with funding from the National Center for Research Resources (M01 RR00533) to Boston University Medical Center. Grateful appreciation is expressed to the staff and cadets of Kalmar Maritime Academy, Kalmar, Sweden, and Boston University for their assistance, to the staff of the General Clinical Research Center for their assistance, and to Donald Davies for his data analyses.

References

Chapman, L. F. (1970). Experimental induction of hangover. *Quarterly Journal of Studies on Alcohol* (Supplement No. 5), 67−86.

Finnigan, F., Schulze, D., Smallwood, J., & Helander, A. (2005). The effects of self-administered alcohol-induced 'hangover' in a naturalistic setting on psychomotor and cognitive performance and subjective state. *Addiction*, *100*, 1680−1689.

Howland, J., Almeida, A., Rohsenow, D., Minsky, S., & Greece, J. (in press). How safe are federal regulations on occupational alcohol use? *Journal of Public Health Policy.*

Kruisselbrink, L. D., Martin, K. L., Megeney, M., Fowles, J. R., & Murphy, R. J. L. (2006). Physical and psychomotor functioning of females the morning after consuming low to moderate quantities of beer. *Journal of Studies on Alcohol*, *67*, 416−420.

McCaul, M. E., Turkkan, J. S., Svikis, D. S., & Bigelow, G. E. (1991). Alcohol and secobarbital effects as a function of familial alcoholism: Extended intoxication and increased withdrawal effects. *Alcoholism: Clinical and Experimental Research*, *15*, 94−101.

Roehrs, T., Yoon, J., & Roth, T. (1991). Nocturnal and next-day effects of ethanol and basal level of sleepiness. *Human Psychopharmacology*, *6*, 307−311.

Rohsenow, D. J., Howland, J., Minsky, S. J., & Arnedt, J. T. (2006). Effects of heavy drinking by maritime academy cadets on hangover, perceived sleep, and next day ship power plant operation. *Journal of Studies on Alcohol*, *67*, 406−415.

Seppala, T., Leino, T., Linnoila, M., Huttumen, M., & Ylikahri, R. (1976). Effects of hangover on psychomotor skills related to driving: Modifications by fructose and glucose. *Acta Pharmacologica et Toxicologica*, *38*, 209−218.

Slutske, W. S., Piasecki, T. M., & Hunt-Carter, E. E. (2003). Development and initial validation of the Hangover Symptoms Scale: Prevalence and correlates of hangover symptoms in college students. *Alcoholism, Clinical and Experimental Research*, *27*, 1442−1450.

Span, S. A., & Earlywine, M. (1999). Familial risk for alcoholism and hangover symptoms. *Addictive Behaviors*, *24*, 121−125.

Ylikahri, R. H., Huttumen, M. O., Eriksson, C. J. P., & Nikkila, E. A. (1974). Metabolic studies on the pathogenesis of hangover. *European Journal of Clinical Investigation*, *4*, 93−100.