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Capturing Meaningful Change: Initiation and Maintenance of Reductions in World Health Organization Risk Drinking Levels Among Mandated College Students

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Abstract

Objective: Reductions in World Health Organization (WHO) risk drinking levels have been used to capture non-abstinent reductions in drinking in the general population and clinical trials. We examined mandated college students' reductions in WHO risk drinking levels 1-month post-intervention, whether reductions were maintained at 5-6 and 12 months, and whether maintenance to 12 months predicted better alcohol-related outcomes. We also explored sex differences throughout.

Method: The sample consisted of non-abstinent mandated students who received a brief motivational intervention (*N*=816). Sex-specific WHO risk levels were calculated from drinks per drinking day at baseline and follow-ups. Additional measures of alcohol use and consequences were assessed at baseline and 12-month follow-up.

Results: Most participants did not initiate reductions in drinking risk level by 1-month follow-up (39.0%). Of those who achieved at least a 1-level reduction, approximately 60% maintained this change at 5-6- and 12-months. Further evidencing maintenance, 1-month reductions predicted an approximately 500% increase in the odds of at least a 1-level reduction at each follow-up. Finally, those who failed to maintain at least a 1-level reduction to 12 months and those who successfully maintained change were generally similar at baseline. However, by 12 months, those who failed to maintain reduced drinking drank more and experienced more consequences than those who maintained changes. There were few sex differences across all results.

Conclusion: Reductions in WHO risk drinking levels hold promise for quantifying meaningful, individual-level initiation and maintenance of reduced drinking among mandated students.

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Keywords

World Health Organization risk drinking levels; mandated college students; reduced alcohol consumption; intervention outcomes; maintenance of change

College students continue to engage in heavy alcohol use, leading to thousands of preventable injuries, sexual and physical assaults, and deaths each year (Hingson et al., 2009; National Institute on Alcohol Abuse and Alcoholism, 2022; Substance Abuse and Mental Health Services Administration, 2019). Students who have violated campus alcohol policies and are mandated to intervention tend to have higher quantity and frequency of alcohol consumption and experience more alcohol-related consequences than other undergraduates (LaBrie et al., 2006; Merrill et al., 2014). Reducing their alcohol use is therefore of high importance.

On average, interventions successfully reduce heavy drinking and mandated students' alcohol use by 1-month, but effects begin to decay by 3 to 6 month follow-ups (Carey et al., 2016; Samson & Tanner-Smith, 2015). Given the focus of these interventions on reduced drinking rather than abstinence, there is a need to identify *which individuals* initiated and maintained reduced drinking. This information can be used to shed light on the modifiable processes that promote maintenance and is required for executing sequentially randomized adaptive interventions that can tailor content to initiation status (Lei et al., 2012). Existing metrics of individual-level, meaningful change (e.g., reliable change; Jacobson & Truax, 1991) have not been widely adopted in the college drinking literature. Researchers might alternatively define meaningful change as the presence versus absence of any heavy drinking or falling above versus below the AUDIT cutoff for hazardous drinking (Babor et al., 2001). However, as binary indicators, these lack information about the magnitude of an individual's change, do not allow for examining change among moderate but non-risky drinkers, and may fail to identify some who drink in risky ways (e.g., females who drink below the daily heavy drinking threshold but exceed weekly limits). As World Health Organization (WHO) risk drinking levels address these shortcomings, we examined their utility for quantifying post-intervention initiation and maintenance of reductions in risk drinking level among mandated students.

WHO risk drinking levels utilize grams of alcohol consumed and sex-specific cutoffs to classify risk associated with alcohol use as very high, high, moderate, or low risk (World Health Organization, 2000). One- and two-level reductions in WHO risk drinking level (e.g., moving from very high to high or moderate risk) have been used in general and clinical samples to capture meaningful change in alcohol use and have demonstrated benefits in both populations. In the general population, achieving at least a 1-level reduction in WHO risk drinking level was concurrently associated with lower alcohol dependence, AUDIT-C scores, and anxiety and depression (Hasin et al., 2017; Knox et al., 2018, 2019). Among individuals receiving treatment for alcohol use disorder, 1-level reductions were widely achieved and maintained, and maintenance of reduced drinking predicted fewer consequences and better mental and physical health at 1 year follow-up (Witkiewitz et al., 2017, 2019, 2020). Thus,

WHO risk drinking levels may be useful for capturing non-abstinent reductions in drinking among college students and maintaining such reductions may confer benefits.

WHO risk drinking levels have been defined using both typical drinks *per drinking day* (Hasin et al., 2017; Knox et al., 2018) and typical drinks *per day* (e.g., Shmulewitz et al., 2021; Witkiewitz et al., 2019), that is, drinks per week divided by the number of drinking days or by seven. Work in nationally representative and mandated student samples demonstrated that the drinks per drinking day definition yielded good distribution of positive scores on the AUDIT across risk categories, such that AUDIT-positive prevalence was low in the low risk category but near 100% in the very high risk category (Knox et al., 2018; Reid et al., 2024). In contrast, the drinks per day definition classified 68% of mandated students as low risk, though 50% in this category were AUDIT-positive and thus would benefit from brief intervention (Reid et al., 2024). Although the drinks per drinking day definition is rarely used with treatment seeking individuals (e.g., Witkiewitz et al., 2020), it appears to be more useful for capturing the nature of most college students' alcohol use—high consumption constrained to a few days per week.

WHO risk drinking levels hold promise for characterizing individual-level, non-abstinent initiation and maintenance of reduced alcohol use but have not been applied to college students. We defined risk drinking levels throughout via drinks per drinking day but report the primary analyses using the drinks per day definition in the supplement for the interested reader. We examined prevalence of achieving at least 1- and 2-level reductions in WHO risk drinking levels by 1 month follow-up (initiation) and whether these 1-level reductions were maintained at shorter- (5-6 months) and longer-term (12 month) follow-ups. We also examined 12-month outcomes among three distinct groups: those who did not initiate at least a 1-level reduction by 1 month (non-changers), those who initiated a 1-level reduction by 1 month but failed to maintain this to 12-months (non-maintainers), and those who initiated and maintained a 1-level reduction from 1 to 12 months (maintainers). We expected maintainers would have lower 12-month typical drinks per week, peak drinking (i.e., most drinks in one day), and consequences than non-maintainers but made no predictions for non-changers relative to non-maintainers. Given the possibility of differences in intervention effects by sex (e.g., Carey et al., 2009), we also explored whether males and females differed across all analyses.

Method

Participants and Procedures

Participants were drawn from three studies conducted at private and public universities (Carey et al., 2009, 2011, 2018). Procedures were approved by each university's Institutional Review Board and participants provided informed consent prior to participation. All participants violated the campus alcohol policy and were mandated to an alcohol intervention (*n*s= 198, 677, 568; years: 2003-2005, 2005-2008, 2011-2013). Participants were largely male (54-72%), freshmen or sophomores (73-96%), and White (84-91%). All studies utilized the same counselor-delivered brief motivational intervention. Two demonstrated better efficacy of the counselor- versus computer-delivered interventions; the third found no differences for norms-focused versus general health boosters added

1-month following the counselor intervention. On average, those who received the counselor intervention reduced drinking at 1-month but returned to baseline levels by 12 months; effects on drinks per week and consequences were similar in magnitude across all three studies (Carey et al., 2018).

To simplify analyses, we focused only on participants who received the counselor-delivered intervention (N= 831). As abstainers could not further reduce their drinking, we excluded 14 students who indicated baseline abstinence on drinks in the typical and heaviest week, peak drinking, and consequences (see also Shmulewitz et al., 2021). One additional student was excluded who did not provide baseline data on any of the alcohol items (final N= 816). Follow-ups occurred at 1, 6, and 12 months in two studies and at 1, 3, 5, 8, and 12 months in the third study. Analyses examining initial reductions in WHO risk levels, shorter-term maintenance, and longer-term maintenance of reduced drinking thus utilized the 1-month, 5 to 6-month, and 12-month assessments, respectively. Analyses were not preregistered.

Measures

WHO Risk Drinking Levels : A 7-day grid was used to assess drinks consumed in a typical week in the last month (Collins et al., 1985); two of the studies referenced the month before the sanction at baseline. Responses were summed across all days to capture typical drinks per week and divided by the number of drinking days. Following prior work (e.g., Hasin et al., 2017), we calculated risk levels assuming 14 grams of alcohol in one U.S. standard drink. For males, risk levels were: very high risk, >100 g (>7.1 drinks); high risk, >60-100 g (>4.3-7.1 drinks); moderate risk, >40-60 g (>2.9-4.3 drinks); and low risk, 1-40 g (1-2.9 drinks). For females, risk levels were: very high risk, >60 g (>4.3 standard drinks); high risk, >40-60 g (>2.9-4.3 drinks); moderate risk, >20-40 g (>1.4-2.9 drinks); and low risk, 1-20 g (1-1.4 drinks). Abstinence was included as the lowest possible risk level at follow-ups (see also Witkiewitz et al., 2019) and required that participants had no drinks in the typical week, heaviest week, or on the peak drinking day, and no consequences. Risk drinking levels were calculated at baseline, 1 month, 5-6 months, and 12 months and used to capture the presence of drinking reductions at each follow-up relative to baseline.

Alcohol-related Outcomes: Peak drinking was assessed by a single item capturing the highest number of drinks consumed in one day in the previous month. Alcohol-related consequences in the last month were assessed using the 23-item Rutgers Alcohol Problem Index (RAPI) in two studies and the 24-item Brief Young Adult Alcohol Consequences Questionnaire (BYAACQ) in one study (Kahler et al., 2005; White & Labouvie, 1989). The RAPI utilizes a five-point scale, and the BYAACQ is dichotomous (yes/ no). RAPI responses were dichotomized, and both measures were summed to form a count of consequences experienced. To facilitate analyzing the scales together, we converted scores to the percent of the maximum possible score (e.g., percent of the 23 RAPI consequences experienced; Cohen et al., 1999).

Covariates: Covariates in regression models included sex (male=1; female=0) and the study in which each student participated. Study was represented by two dummy codes, with the public university study as the reference, compared against each private school study.

Analysis Plan

We first conducted descriptive analyses to characterize the prevalence of initiating and maintaining change in WHO risk drinking levels. To provide further evidence of maintenance, logistic regression models examined whether achieving at least a 1-level reduction by 1 month predicted 1-level reductions at 5-6 and 12-month follow-ups. To examine benefits of maintenance, six regression models examined whether those who initiated but failed to maintain at least a 1-level reduction in risk level (non-maintainers; 0) differed from those who either made no change (non-changers; 1) or who achieved and maintained change (maintainers; 1). Groups were compared with respect to baseline and 12-month drinks per week, peak drinking, and consequences. Sex differences were examined via chi-square tests or interactions in regression models. Regression analyses were executed using Bayesian estimation in Blimp analytic software version 3.0 (Keller & Enders, 2021) to address missing data, which ranged from 4% to 41% at follow-ups. Bayesian estimation performs similarly to multiple imputation but directly estimates model coefficients for both continuous and categorical variables (Enders et al., 2020). The Bayesian approach generates a distribution of estimates for each model parameter. The median and standard deviation of the posterior distribution provide estimates similar to frequentist coefficients and standard errors. Significance occurs when the 95% credible interval fails to include zero for continuous variables or one for dichotomous variables. The potential scale reduction factor was used to verify convergence of the Markov chain Monte Carlo algorithm prior to interpreting results (Gelman & Rubin, 1992). Requests to access the data or for the syntax used for analyses should be directed to the second and first author, respectively.

Results

As shown in Table 1, the majority of students demonstrated no change or increased drinking by 1 month. In all, 39% of participants initiated at least a 1-level reduction in alcohol use by 1 month, with a one-level reduction being most common. Those demonstrating higher risk at baseline had a higher likelihood of initiating at least a 1-level reduction. Indeed, 58% of those classified as very high risk at baseline initiated at least a 1-level reduction by 1 month; this was only true among 15% of those classified low risk at baseline. Males had 37% lower odds than females of achieving at least a 1-level reduction in drinking at 1 month.

The majority of participants who initiated at least a 1-level reduction in drinking by 1 month maintained those reductions at the shorter- and longer-term follow-ups (see Table 2). Among those who initiated change by 1 month but later returned to a higher WHO risk drinking level, most of the reversion occurred prior to 5-6 months, with few additional reversions between the 5-6 and 12-month follow-ups. Males and females did not differ in the percent who initiated and maintained a 1-level reduction across the follow-ups ($ps > .70$). Logistic regression models further supported that reductions in WHO risk levels were more often than not maintained. Initiating at least a 1-level reduction in drinking by 1-month predicted a 510-573% increase in odds of having at least a 1-level reduction at the 5 to 6-month and 12-month follow-ups (95% credible intervals: 4.48, 10.35; 4.02, 9.31, respectively). These strong associations of 1 month 1-level reductions with 5 to 6- and 12-month 1-level reductions were not moderated by sex (95% credible intervals: −0.59, 1.04; −0.50, 1.11).

Finally, we compared differences in alcohol-related outcomes at baseline and 12 months among those who initiated at least a 1-level reduction in risk level by 1 month but failed to maintain it to 12 months (non-maintainers) versus those who made no change (non-changers) and those who maintained at least a 1-level reduction to 12 months (maintainers; see Table 3). Non-changers (72% of sample) did not differ from non-maintainers (12%) on any variables at baseline and the groups remained similar on all outcomes at 12 months. Similarly, at baseline, maintainers (16%) did not differ from non-maintainers on peak drinking or consequences, but maintainers consumed three more drinks per week than non-maintainers. However, by 12 months, maintainers were lower on all outcomes; relative to non-maintainers, maintainers had approximately seven fewer drinks per week, three fewer drinks on their peak occasion, and 6% fewer consequences. Across all comparisons of non-maintainers, non-changers, and maintainers, sex differences only emerged in one case, comparing non-maintainers and maintainers in 12-month drinks per week (95% credible interval: −11.03, −0.30). The overall effect, in which maintainers had fewer drinks per week than non-maintainers, was evident for males (effect: −9.51; 95% credible interval: −13.30, −5.89) but not females (Effect: −3.80; 95% credible interval: −7.89, 0.25).

Discussion

Our results support the utility of WHO risk drinking levels for defining initiation and maintenance of reduced drinking among mandated college students. Results indicated that a minority of students initiated at least a 1-level reduction in drinking by 1-month. However, those who did so tended to maintain reductions at shorter- and longer-term follow-ups. This is notable, as higher risk drinkers were more likely to initiate at least a 1-level reduction. Comparisons of those who had not reduced drinking by 1 month (non-changers) and those who failed to maintain changes to 12 months (non-maintainers) indicated no differences between the groups in alcohol use or consequences at baseline or 12 months. In contrast, non-maintainers were similar to or lighter drinkers at baseline than those who maintained change (maintainers), yet drank more and experienced more consequences at 12 months. Finally, there were few sex differences across the results, suggesting the broad utility of WHO risk levels for capturing post-intervention change.

Alternative approaches have been used to capture post-intervention change among college students. Henson et al. (2015) performed latent class analysis on heavy drinking outcomes and concluded that the majority of students reduced drinking post-intervention but failed to maintain reductions. This conclusion is similar to what might be inferred from the original studies' average mean effects—significant 1-month reductions that decayed by 12 months (Carey et al., 2018)—as well as meta-analyses of the college alcohol intervention literature (e.g., Carey et al., 2016). In contrast, we found that a minority reduced risk drinking level at 1-month, but those who did tended to maintain reductions. Our differing conclusions likely reflect examination of statistically significant versus meaningful change. Research examining reliable change, reflecting change that exceeds measurement error (Jacobson & Truax, 1991), similarly found that only 34% of high risk students demonstrated change two years following a counselor-delivered intervention (Roberts et al., 2000). Research comparing the utility of measures of meaningful change will provide useful information for researchers and practitioners considering alternatives to statistically significant change.

Despite being similar to or less risky than maintainers at baseline, non-maintainers drank significantly more by 12-month follow-up. This suggests that more than a single-session intervention is needed to promote maintenance for students who achieved but failed to maintain reduced drinking. Research is therefore needed that identifies the constructs and corresponding intervention strategies that might improve maintenance in this population. In addition, as a substantial number of students classified as moderate to very high risk failed to initiate change in risk level by 1-month, alternative interventions that might encourage initiation are also needed. Sequentially randomized adaptive interventions (Lei et al., 2012), which can deliver content matched to participants' post-intervention trajectory of change, would be especially well-suited for addressing these dual goals of encouraging both initiation and maintenance.

This study had several limitations. Results may not generalize to non-mandated students or community dwelling young adults. Both typically drink less alcohol than mandated students (Blanco et al., 2008; Merrill et al., 2014) and may respond differently to intervention. Thus, comparison of our results with intervention outcomes in other heavy drinking young adult populations is warranted. In addition, the data were self-report and may reflect biased reporting of behavior, though self-report alcohol use correlates well with objective measures (Carey & Hustad, 2002). These limitations are countered by the study's strengths, including use of a large sample who all received a brief motivational intervention and examination of a promising approach for characterizing meaningful, non-abstinent reductions in drinking.

Conclusion

WHO risk drinking levels hold promise for capturing meaningful change in college students' alcohol use following brief interventions. Using WHO risk drinking levels to characterize post-intervention change will enable research that aims to identify intervention strategies that best support initiation versus maintenance of reduced drinking. Ultimately, work that differentiates categories of intervention response may provide a step toward the goal of developing more efficacious, longer lasting interventions.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Public health significance statement

This study indicates that, using World Health Organization risk drinking levels to define change, only a minority of students who violated the campus alcohol policy achieved reduced risk by 1-month following a counselor-delivered brief motivational intervention. However, most who initiated changes by 1 month successfully maintained those changes at 5-6 and 12-month follow-ups.

Table 1

Initiation of Reduced Drinking at 1 Month by Baseline WHO Risk Level

	Initiation Status by 1-month			
Baseline risk level	**No change or increase**	**Non-abstinent 1-level reduction**	**Non-abstinent 2- or 3-level reduction**	**Became abstinent**
Low risk(*n* = 114, 14%)	85%	NA	NA	15%
Moderate risk(*n* = 171, 21%)	61%	33%	NA	6%
High risk(*n* = 309, 38%)	65%	22%	10%	3%
Very high risk(*n* = 222, 27%)	42.5%	35%	17.5%	5%
Total	61%	25%	8%	6%

Table 2

Maintenance of Reduced WHO Risk Drinking Level at Short- and Longer-term Follow-ups

	5-6 month status		12-month status	
1 month status	**No change or increase**	**At least a 1-level reduction**	**No change or increase**	**At least a 1-level reduction**
No change or increase	82%	18%	82%	18%
At least a 1-level reduction	40%	60%	43%	57%

Table 3

Associations of 12 Month Maintenance Status with Alcohol-related Outcomes at Baseline and 12 Months

	Non-maintainers (0) vs. Non-changers (1)			
	Baseline outcomes		12-month outcomes	
	Effect	**95% credible interval**	**Effect**	**95% credible interval**
Drinks per week	−0.20	−2.46, 2.08	0.66	−1.69, 3.02
Peak drinking	−0.40	−1.41, 0.61	0.17	−1.24, 1.60
Consequences	−2.85	−7.12, 1.14	−0.96	−5.71, 3.57
	Non-maintainers (0) vs. Maintainers (1)			
	Baseline outcomes		12-month outcomes	
	Effect	**95% credible interval**	**Effect**	**95% credible interval**
Drinks per week	3.11	0.33, 5.87*	−6.94	−9.62, −4.22*
Peak drinking	0.83	−0.40, 2.07	−3.20	−4.87, −1.56*
Consequences	3.42	−1.69, 8.34	−6.26	−11.65, −0.81*

Note.

*95% credible interval failed to include zero.