Effects of 21st Birthday Brief Interventions on College Student Celebratory Drinking: A Systematic Review and Meta-Analysis

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Abstract

Introduction—College students' 21st birthday celebrations often involve consumption of extreme amounts of alcohol as well as alcohol-related risks. This systematic review aims to determine whether birthday-focused, individually-targeted, no-contact (email or letter-based) brief alcohol interventions (BAIs) reduce college students' 21st birthday celebratory drinking.

Methods—A systematic search identified 9 randomized evaluations with 10 interventions to reduce 21st birthday drinking. Quantity of alcohol consumed and estimated blood alcohol concentration (BAC) were measured. Random-effects meta-analysis was used to summarize the effects of the interventions.

Results—There was no evidence that birthday-focused BAIs reduce quantities of alcohol consumed during birthday celebrations ($\bar{g} = 0.05$, 95% CI [-0.03 to 0.13]). The interventions were associated with significant reductions in estimated BAC levels ($\bar{g} = 0.20$, 95% CI [0.07 to 0.33]), but this effect was small in absolute terms. The quality of this body of evidence was very low, as evaluated using the GRADE approach. In particular, it was limited by substantial participant attrition post-randomization due to included studies' recruitment and randomization procedures.

Conclusions—There is no evidence that birthday-focused, individually-targeted BAIs reduce the quantity of alcohol consumed by students during 21st birthday celebrations, although these interventions may yield small beneficial effects on estimated BAC. Many methodological concerns were identified in included studies. This area of research would benefit from theory-based RCTs that are well-designed and executed. Future research should also investigate strategies other than birthday-focused, individually-targeted, brief interventions to curb 21st birthday celebratory drinking.

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1. Introduction

Risky alcohol use is a serious public health issue among U.S. college students. In 2011, approximately 61% of full-time college students reported past-month alcohol use, 39% reported binge drinking, and 14% were heavy drinkers (SAMHSA, 2012). Heavy episodic drinking is associated with many negative consequences, including drunk-driving, traffic deaths, unintentional injuries, and physical and sexual assault (Dermody, Cheong, & Walther, 2012; Hingson, Zha, & Weitzman, 2009; NIAAA, 2002). Rapid consumption of large quantities of alcohol, and blood alcohol concentration (BAC) levels exceeding 0.26 have also been linked to severe medical outcomes including coma, respiratory paralysis, and heart failure (Berger, 2000; Neighbors, Spieker, Oster-Aaland, Lewis, & Bergstrom, 2005; Rutledge, Park, & Sher, 2008).

1.1 Event-Specific Drinking and 21st Birthday Celebrations

Most research on risky college drinking focuses on students' general alcohol consumption. However, researchers in the last decade have begun investigating specific events during which students purposefully drink more alcohol (Neighbors et al., 2007). Such event-specific, ritualistic heavy alcohol consumption typically occurs on holidays, spring break, sporting events, and 21st birthday celebrations (Del Boca, Darkes, Greenbaum, & Goldman, 2004; Lee, Maggs, & Rankin, 2006; Neighbors, Oster-Aaland, Bergstrom, & Lewis, 2006; Oster-Aaland & Neighbors, 2007; Smith, Bogle, Talbott, Gant, & Castillo, 2006).

Many school administrators are particularly concerned about 21st birthday celebrations. Given the symbolic nature of 21st birthdays, many students include alcohol in celebrating this rite of passage into legal-age drinking (Neighbors et al., 2005). Students may be subject to peer pressure, drinking games, and competitions, such as drinking 21 shots or as much as possible in one "power hour" (Hembroff, Atkin, Martell, McCue, & Greenamyer, 2007; Neighbors et al., 2005; Neighbors et al., 2009; Rutledge, et al., 2008). Two studies found that 90% of students reported drinking during their celebration, 75% went to a bar, and 61% had BACs above the legal driving limit (Neighbors et al., 2005, 2006). Also, 68% of female and 79% of male students participating in birthday celebrations reported binge drinking, while 35% of female and 49% of male birthday drinkers had estimated BACs of 0.26 or higher (Rutledge, et al., 2008).

1.2 Event-Specific Prevention

Increased media focus on dangerous 21st birthday drinking traditions (Parker-Pope, 2008) and research confirming heavy alcohol consumption during these events have fueled interest in interventions targeting risky 21st birthday drinking. These efforts are part of a new "event-specific prevention" movement (Neighbors et al., 2007, 2012) with roots in traditional alcohol interventions for college students. Because drinking at these events is

planned, researchers have proposed that hazardous, event-specific drinking is amenable to targeted interventions that coincide with the event (Neighbors et al., 2012).

Brief alcohol interventions (BAIs) are increasingly popular strategies to prevent heavy drinking during 21st birthday celebrations. Birthday-focused interventions may involve information about alcohol poisoning, guidance about harm reduction (e.g., Smith et al., 2006), personalized feedback (e.g., Neighbors et al., 2009), or messages highlighting misperceptions of peer drinking levels (e.g., Glassman, 2010). One example of BAIs, the B.R.A.D. birthday card, conveys the story of a Michigan student's death due to alcohol poisoning, provides information about alcohol poisoning symptoms, and reminds students to celebrate responsibly (B.R.A.D., 2013; Hembroff et al., 2007; Martell & Atkin, 2002). The B.R.A.D. card and similar interventions have been disseminated to students on over 100 campuses (Glassman, Dodd, Kenzik, Miller, & Sheu, 2010; Smith et al., 2006).

1.3 Objectives

Numerous systematic reviews and meta-analyses have examined the effectiveness of non-event specific interventions targeting college student drinking, generally reporting positive effects on alcohol consumption levels (Carey, Scott-Sheldon, Carey, & DeMartini, 2007; Carey, Scott-Sheldon, Elliott, Bolles, & Carey, 2009; Walters, Miller, & Chiauzzi, 2005). Some reviews have similarly reported beneficial effects for computer-delivered (Carey et al., 2009; Moreira, Smith, & Foxcroft, 2009; White et al., 2010; Zisserson, Palfai, & Saitz, 2007) and personalized-feedback interventions relative to assessment-only or information-only controls (Riper et al., 2009; Walters & Neighbors, 2005). The largest meta-analysis to date demonstrated that BAIs led to significant reductions in alcohol consumption among adolescents ($\bar{g} = 0.27$) and young adults ($\bar{g} = 0.17$) relative to no treatment or treatment as usual conditions (Tanner-Smith & Lipsey, 2015).

Several randomized trials have been conducted to investigate the impact of birthday-focused, individually-targeted BAIs to reduce students' 21st birthday drinking. We are unaware of any prior reviews that have systematically identified all evaluations of 21st birthday interventions and statistically synthesized their effects. This meta-analysis fills this gap by synthesizing findings from trials examining the effects of 21st birthday-focused BAIs on college students' celebratory drinking. We chose to focus on 21st birthdays (rather than other events) given the ubiquitous nature of birthday celebrations at colleges and the growing body of relevant evaluation research.

2. Methods

2.1 Inclusion Criteria

This meta-analysis included a subset of studies from a larger systematic review on BAIs for youth (Tanner-Smith & Lipsey, 2015). Eligible studies had to evaluate birthday-focused, no-contact interventions delivered via mail or electronically to students approaching their 21st birthday. Eligible research designs included randomized and quasi-experimental studies comparing a BAI to a no treatment, "straw man", or attention/sham condition. Eligible studies had to assess intervention effects on at least one outcome measuring alcohol

consumption during 21st birthday celebrations. A priori criteria included studies conducted in 1980 or later, regardless of geographic location or reporting language.

2.2 Search Strategies and Coding Procedures

The following databases were searched through December 31, 2012: ERIC, International Bibliography of the Social Sciences, PsycARTICLES, PsycINFO, Social Services Abstracts, Sociological Abstracts, PubMed, CINAHL, Dissertation Abstracts International, Clinical Trials Register, NIH RePORTER, and WorldWideScience.org. We also conducted extensive grey literature searching, including websites, conference proceedings, journal hand-searching, and reference-mining bibliographies (Tanner-Smith & Lipsey, 2015).

Under the supervision of the project's principal investigator (this study's second author), a team of six masters' level research assistants screened all titles/abstracts to eliminate clearly irrelevant reports. Full-text versions of remaining reports were retrieved and screened for eligibility. The same team then extracted data from all eligible reports. The second author checked all coding, and coding disagreements were resolved via consensus (Tanner-Smith & Lipsey, 2015). Studies were coded on variables capturing intervention details, participant characteristics, study methods, statistical findings, and general study characteristics. The participant characteristics of interest were gender, ethnicity, and modal alcohol use in the intervention group (ranging from 1 = mostly abstainers to 4 = hazardous users). Intervention characteristics included: delivery mode (mailed vs. computerized), and intervention components (advice, feedback, norm-referencing, campus/proximal feedback, education/information about negative alcohol consequences, information about BAC). Methodological characteristics included: study design (RCT vs. quasi-experimental), whether randomization occurred prior to approaching participants, whether baseline data were collected, time of intervention delivery, post-randomization attrition rates, intention-to-treat (ITT) vs. completer analysis, inclusion of a CONSORT-style participant flow diagram, and comparison group type (Schulz, Altman, & Moher, 2010). These were selected based on prior theory and research about alcohol interventions for college students (Carey et al., 2007, 2009; Cronce, & Larimer, 2011; Elliott, Carey, & Bolles, 2008; Walters & Neighbors, 2005).

2.3 Statistical Methods

2.3.1 Effect size metric—We extracted data on two different drinking measures: quantity of alcohol consumed and blood alcohol concentration (BAC) during 21st birthday celebrations. Intervention effects were measured using standardized mean difference effect sizes (Hedges' *g*), coded so positive effect sizes represent better outcomes (i.e., lower BAC) (Hedges, 1981).

2.3.2 Analytic strategies—Standard meta-analysis methods were used to synthesize effect sizes across studies (Lipsey & Wilson, 2001). Given the presumed heterogeneity in the studies, all analyses were conducted using inverse-variance weighted random effects models. Heterogeneity was estimated using the Q, I^2, and τ^2 statistics, which test for the presence of heterogeneity, the proportion of variability due to true heterogeneity, and the amount of variance in the distribution of the true effect sizes (DerSimonian & Laird, 1986;

Huedo-Medina, Sánchez-Meca, Marin-Martinez, & Botella, 2006). All analyses were performed using Stata SE 13 (64-bit). One effect size outlier (LaBrie, Migliuri & Cail, 2009) was Winsorized (i.e., recoded to a less extreme value) to prevent distortion of the meta-analysis results. To satisfy the assumption of statistical independence of effect sizes, we meta-analyzed findings for the quantity of alcohol consumed and BAC outcomes separately. Furthermore, when studies included multiple interventions that shared a single comparison group, we included the most "comprehensive" interventions in the analytic sample. Sensitivity analyses were used to assess the impact of Winsorizing and analytic sample selections on the stability of meta-analysis results.

We examined the correlation between effect sizes for quantity of alcohol consumed and characteristics of participants, interventions, methods, and studies; too few studies provided BAC effect sizes to permit estimation of correlations for that outcome. We also examined contour-enhanced funnel plots (Peters et al., 2006) and conducted regression tests for funnel plot asymmetry (Egger et al., 1997) to assess the possibility of publication bias. We further assessed risk of bias for each study using the Cochrane Risk of Bias Tool (Higgins et al., 2011). Performance bias by provider was de facto considered low risk because the interventions were mailed or electronically delivered, whereas performance bias by recipient was de facto considered high risk since participants necessarily were aware of the intervention they received. Finally, the overall confidence in the results for each outcome was assessed using the Grading of Recommendations Assessment, Development and Evaluation Working Group (GRADE) approach (Guyatt, Oxman, Schunemann, Tugwell, & Knotterus, 2010). This approach—adopted by the Cochrane Collaboration, World Health Organization, and numerous other organizations— rates the quality of the body of evidence for each outcome based on study risk of bias, directness of the evidence to the research question, consistency (magnitude of heterogeneity), precision, and possible publication biases (Davoli et al., 2014; Higgins & Green, 2011).

3 Results

3.1 Literature Search

We identified 7,593 reports, of which 2,467 were duplicates, and 2,641 were screened as ineligible at the abstract phase (Tanner-Smith & Lipsey, 2015). Of the 2,484 articles retrieved in full text format, 2,473 were deemed ineligible (see Figure 1). Our final review included 9 studies reported in 11 documents (Moher, Liberati, Tetzlaff, & Altman, 2009).

3.2 Description of Included Studies

Study characteristics are shown in Tables 1 and 2. The analytic sample size included 1,513 students across all nine studies. Because one study provided effect sizes comparing two unique interventions with two unique comparison groups, there were ten intervention conditions included in the meta-analysis. On average, 41% of the intervention participants were male, 75% were White, and 17% were part of a Greek organization. Most interventions included a norm-referencing component (e.g., "81% of LMU students consume five or less drinks during a typical night of partying/drinking … where do you fit in?"), and half involved education about alcohol (e.g., symptoms of alcohol poisoning). Four interventions

provided information about alcohol-related negative consequences and/or proximal feedback about alcohol consumption by other students at the same campus. Most interventions were delivered in print via mail (versus electronically). Interventions were mostly compared to no-treatment conditions. Two comparison groups received non-alcohol related information (e.g., a card with happy birthday wishes), and one received a diluted version of the program with educational information about alcohol (Dodd, Glassman, Kenzik, & Miller, 2009; Glassman et al., 2010).

3.3 Risk of Bias in Included Studies

Overall, studies demonstrated substantial risk of bias in several domains. All studies used randomized designs, but the majority did not provide clear information about random sequence generation (78%) or allocation concealment (89%). Eight studies were at high risk of detection bias due to lack of blinding of outcome assessment; in all studies, outcome data for quantity of alcohol consumed was self-reported by the students, while the BAC data were calculated by authors of the studies using student-reported data. Seven studies were at high risk of attrition bias, because most did not report consenting and screening students for eligibility prior to randomizing them to interventions. The average overall post-randomization attrition rate across groups was high at 47%. Five studies employed an ITT analysis, two reported collecting baseline data, and two provided a CONSORT-style participant flow diagram. Risk of selective outcome reporting was unclear in eight studies due to lack of a study protocol or pre-registration of the trial.

To assess risk of publication bias we inspected a contour-enhanced funnel plot for the quantity of alcohol outcomes (see Appendix). The funnel plot was fairly symmetric, and results from the Egger's regression test ($b = 0.79$; $p = 0.54$) provided no evidence of small study bias.

3.4 Overall Effects on 21st Birthday Celebration Drinking

For the quantity of alcohol consumed, nine independent effect sizes (from eight studies) ranged from -0.21 to 0.48 (see Figure 2). Although most individual effect sizes were positive (i.e., favoring intervention conditions), none were significantly different from zero. When results were pooled, there was no evidence that 21st birthday BAIs were associated with significant reductions in quantity of alcohol consumed during birthday celebrations ($\bar{g} = 0.05$, 95% CI [-0.03,0.13], $\tau^2 = 0.001$, $Q = 8.62$, $I^2 = 7.2\%$). However, the quality of this body of evidence was very low (see Table 3 for details).

Five of the nine eligible studies reported data on BAC during 21st birthday celebrations (see Figure 3). Effect sizes ranged in magnitude from 0.03 to 0.54. Meta-analysis results indicated that 21st birthday BAIs were associated with significant reductions in students' BAC during their birthday celebrations ($\bar{g} = 0.20$, 95% CI [0.07, 0.33], $\tau^2 = 0.00$, $Q = 3.69$, $I^2 = 0$). Using the mean BAC level of the comparison groups included in the meta-analysis, this effect size of 0.20 translates into a 0.03 reduction in BAC. Again, this body of evidence was of very low quality (see Table 3).

3.5 Supplemental Analyses

Results from both meta-analyses indicated homogeneity in effects (i.e., small τ^2, I^2, and Q values). Although we originally intended to examine whether any variables shown in Table 2 moderated intervention effects, homogeneity and the small number of studies precluded complex moderator analyses. Nevertheless, for informational purposes, Table 2 presents the inverse-variance weighted bivariate correlations between each variable and the quantity of alcohol consumed effect sizes. There were no significant associations between effect sizes and sample characteristics, study quality indicators, or interventions features. Effect estimates were higher when birthday BAIs were contrasted with inactive, untreated comparisons versus 'straw man' or attention comparisons.

We also conducted sensitivity analyses to explore the robustness of findings. Excluding the only cluster RCT with the outlying effect size (LaBrie et al., 2009) resulted in smaller mean effect sizes for both outcomes but the substantive results remained unchanged ($\bar{g}$ = 0.04, 95% CI [-0.04, 0.11] for alcohol quantity; $\bar{g}$ = 0.17, 95% CI [-0.03, 0.31] for BAC). Winsorizing the same outlying effect size did not substantively change the findings ($\bar{g}$ = 0.05, 95% CI [-0.03, 0.13] for alcohol quantity; $\bar{g}$ = 0.20, 95% CI [0.06, 0.34] for BAC). We also examined the impact of selecting the most "comprehensive" interventions to ensure the statistical independence of effect sizes. Inclusion of B.R.A.D. and risk reduction instead of comprehensive interventions increased the weighted mean alcohol quantity effect size ($\bar{g}$ = 0.08, 95% CI [0, 0.16]) but the mean effect size remained statistically non-significant. Substituting comprehensive interventions with social norms interventions increased the overall alcohol quantity effect size to $\bar{g}$ = 0.09 (95% CI [0.01, 0.17]); this effect was statistically significant but small in substantive magnitude.

4. Discussion

4.1 Summary of Main Results

We used meta-analytic methods to synthesize findings from nine randomized trials examining the effects of 21st birthday-focused, individually-targeted, no-contact BAIs on college students' celebratory birthday drinking. Overall, the quality of this body of evidence was very low. There was no evidence that these interventions were associated with significant reductions in quantity of alcohol consumed during students' 21st birthday celebrations. However, these interventions were associated with statistically significant improvement in students' BAC during 21st birthdays ($\bar{g}$ = 0.20)—equivalent to a BAC of 0.15 in comparison conditions reduced to 0.12 in the BAI conditions. These modest effects on BAC are similar to findings observed for other health promotion strategies targeting addictive behaviors (Johnson, Scott-Sheldon, & Carey, 2010), but effects on quantity of alcohol consumed are smaller than effects observed for general BAIs targeting young adults (Tanner-Smith & Lipsey, 2015; Riper et al., 2009).

4.2 Interpretation of Study Results

The findings for BAC outcome are somewhat encouraging considering the minimal nature of the interventions. A 0.03 reduction in BAC (from 0.15 to 0.12) among students receiving the intervention would likely prevent gross motor impairment and the onset of dysphoria.

However, it is unclear why these significant reductions in BAC were not paralleled with a significant reduction in the quantity of alcohol consumed. One possible explanation is that students receiving the BAIs might have been more likely to space out their drinking in time, thereby reducing their BAC levels (NHTSA, 1994). In all studies, BAC calculations included amount of time spent drinking. However, only one of the five studies (Lewis et al., 2008) provided results for length of drinking episode and reported negligible differences between groups for this outcome. Students receiving the intervention might have also increased consumption of food and non-alcoholic beverages, or applied other moderation or harm-reduction strategies (Clarke, 2007). One study reporting BAC outcome (Neighbors et al., 2009) measured students' protective behavioral strategies during their birthday celebration but the results did not indicate that these behaviors were an underlying mechanism for intervention efficacy. An alternative and perhaps most plausible explanation for the difference in findings for drinking quantity and BAC could be reporting bias in the reviewed literature. The five studies providing data for BAC also reported the largest effects for quantity of drinking, and thus might reflect an overestimate of the effect on BAC. As such, the improvements observed for BAC may be upwardly biased, and must be interpreted with caution. Nonetheless, the average BAC post-intervention was still quite high and at the level of legal intoxication, indicating that 21st birthdays are indeed a risky drinking event.

Various factors might have contributed to the minimal effects of the interventions on students' alcohol consumption, foremost of which are the methodological problems in the included studies. Many trials suffered from substantial attrition, with response rates under 30% when randomization occurred prior to screening and consent. Randomization before consent can lead to excessive overall and differential attrition. Many studies also involved per-protocol rather than intention-to-treat analyses, likely because they did not collect baseline data.

Theory-based choice of outcomes may also advance this literature. Few studies collected (or reported) data on negative consequences from the night of drinking, even though most interventions were based on a harm reduction approach that aims to reduce adverse consequences rather than drinking *per se*. Future researchers should consider specific consequences (e.g., missing school or work the next day, alcohol poisoning) linked to the event in question, rather than using general negative consequence measures. More research is needed to clarify the specific consequences associated with 21st birthdays (Lewis et al., 2008) and to develop core outcome sets (Gargon, Williamson, Altman, Blazeby, & Clarke, 2014) for event-specific prevention to facilitate consistent use of theory-based outcomes in future trials.

Another factor to consider might be the timing of intervention implementation. Many students form their birthday celebration intentions about one month before they turn 21, whereas most included studies delivered the intervention one week prior to participants' birthdays (Clarke, 2007). Therefore, birthday BAIs may not reach their full potential if they are applied after high-risk drinking intentions are already formulated. Evaluating the importance of intervention timing will enhance an understanding of the relative costs and benefits of intervening at different points and maximize resource utilization to impact celebratory drinking levels (Neighbors et al., 2012).

4.3 Future Research

Results from exploratory analyses provided limited guidance about best strategies or settings under which 21st birthday-focused, no-contact BAIs would lead to reduced celebratory drinking. Effect estimates were higher when interventions were set against untreated rather than 'straw man' or attention comparisons; future researchers conducting trials on these interventions should carefully choose comparison groups in line with study objectives (e.g., efficacy versus effectiveness trials) (Heather, 2014). Otherwise, there was little evidence of variability across other measured study characteristics. Prior literature indicates the beneficial effects of feedback and social norms information on alcohol use among college students (Moreira et al., 2009; Riper et al., 2009; Walters & Neighbors, 2005). The same normative misperceptions targeted by efficacious generalized interventions for college student drinking (Moreira et al., 2009) have also been documented specifically for 21st birthday drinking (Neighbors, et al., 2006). The type of norm (injunctive, descriptive) and the targeted population (universal, indicated, selected) may also matter (Smith et al., 2006). While included studies with normative components did not all demonstrate positive effects, these same studies indicated limitations in their intervention design, such as the use of distal reference groups for normative information (Lewis et al., 2008). To avoid iatrogenic effects, another strategy is to give personalized target numbers of drinks per hour for the night—based on participants' gender, weight, and intended length of drinking—to stay below a target BAC. Normative messages sent via personal notes or interactions with one's Resident Advisor, or those targeting individuals within the same dorm, could also bolster receptivity of the messages (LaBrie et al., 2009).

Research suggests that well-timed "general" alcohol interventions may be more effective in reducing 21st birthday celebratory drinking risks than event-specific interventions (Neighbors et al., 2012). Promising general approaches include expectancy challenge scenarios, decisional balance and goal-setting exercises, personalized BAC cards, personalized normative feedback, and information about the financial costs associated with drinking (Tanner-Smith & Lipsey, 2015). These approaches may warrant greater attention as possibilities for addressing event-specific alcohol consumption among college students. Contextual factors are also important to target (Craig et al., 2008; Neighbors et al., 2012). Broader approaches based on ecological models of development (McLeroy, Bibeau, Steckler, & Glanz, 1988) might combine individual, public health, and policy-level interventions (Neighbors et al., 2012) by targeting social factors like friends buying celebrants drinks (Hembroff et al., 2007), bars and campus environments where students drink (Glassman et al., 2010; Neighbors et al., 2005, 2006), or cultural perceptions of birthday drinking as a rite of passage.

Our meta-analysis focused on one type of event associated with heavy drinking. Literature on event-specific drinking would benefit from more research on other types of events, such as football tailgating or spring break. Above all, more rigorously sound research is needed. The small number of eligible studies and low quality of this body of evidence limited our confidence in effect estimates. Future trials should, in particular, seek to recruit and gain consent from participants prior to randomization to prevent substantial post-randomization attrition and better ensure group equivalence at follow-up (Neighbors et al., 2009, 2012).

4.4 Limitations

The small number of studies included in this meta-analysis and lack of overall intervention effectiveness precluded any complex moderator analyses, which might have permitted better understanding of components necessary for reduced drinking during 21st birthdays. Nonetheless, homogeneity of the effects provided evidence of relatively consistent results across studies. Sensitivity analyses confirmed the consistency in effects regardless of our analytic decisions. The reviewed studies included predominantly White participants at U.S. universities, however, so it is unknown whether or how appropriate these interventions are for more diverse student populations or educational contexts. Further, this meta-analysis included primarily inactive comparison groups, and did not assess the relative effects of the interventions contrasted with other active conditions. Finally, we were unable to evaluate intervention effects on other important outcomes (e.g., DUI, injuries associated with birthday drinking) or assess student use of protective behaviors because they were not reported in the included studies.

4.5 Conclusions

Birthday-focused, no-contact BAIs may be inexpensive and easy to distribute, but they may have no (or minimal) effects on college students' alcohol use during their 21st birthday celebrations relative to untreated comparisons. The paucity and methodological limitations of this research literature make our confidence in the effect estimates uncertain, and preclude inferences about the most effective focus, timing or format of such interventions. More complex intervention approaches may be necessary to reduce 21st birthday drinking. Given the potentially fatal consequences of excessive celebratory drinking, additional research is needed to identify and further develop effective interventions for risky 21st birthday drinking and to advance event-specific prevention.
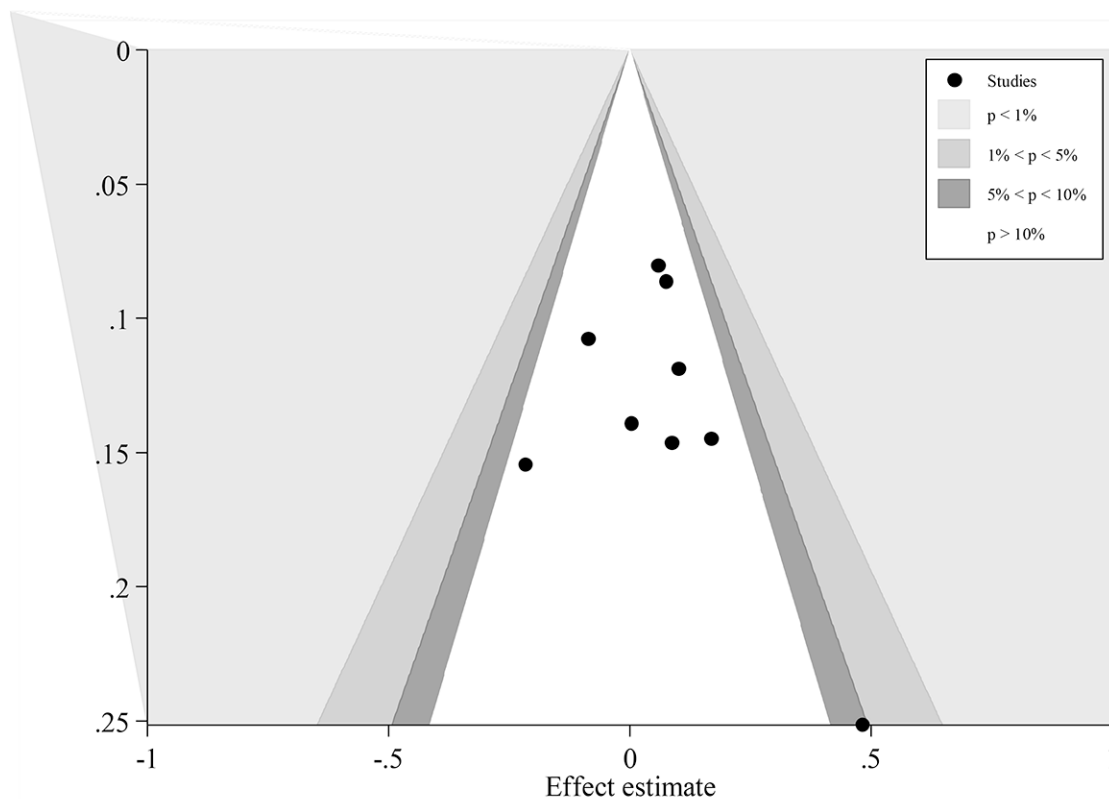
Acknowledgments

Appendix

Figure A.1. Contour-enhanced funnel plot for quantity of alcohol consumed outcome

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Highlights

- We meta-analyzed the effects of brief 21st birthday alcohol interventions.

- We identified 10 individually-targeted, no-contact (email or letter-based) interventions implemented to reduce 21st birthday drinking.

- There was no evidence that these interventions were associated with statistically significant reductions in quantity of celebratory alcohol use.

- Analyzed interventions were associated with a decrease in 21st birthday estimated BAC levels.

- Most included studies had notable methodological limitations, making the quality of this body of evidence very low.
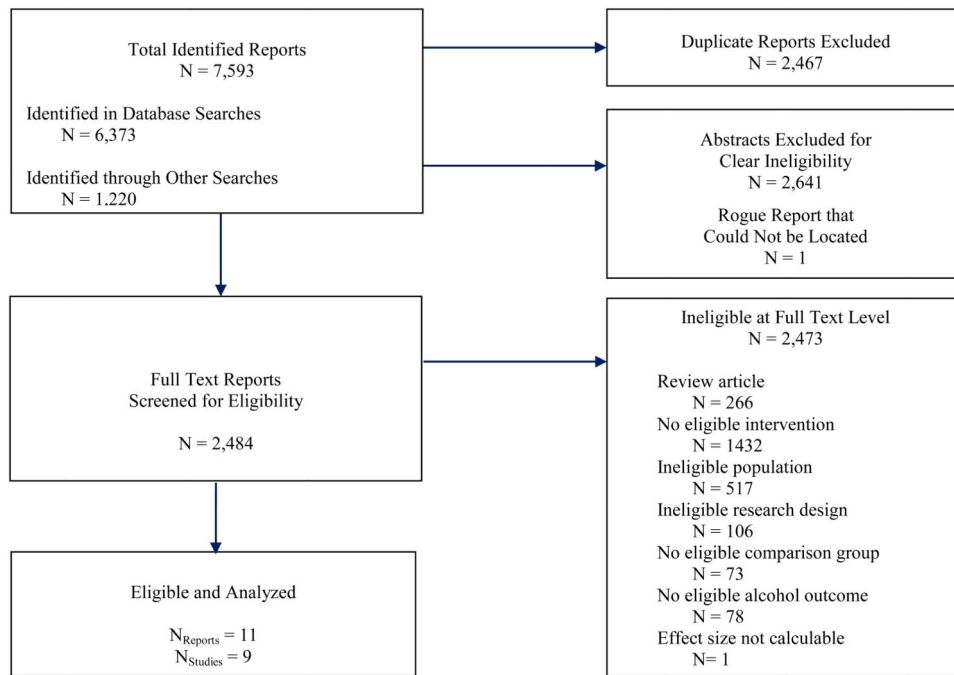
Figure 1.
Flow diagram of studies in systematic review and meta-analysis.

Study		Hedges' g (95% CI)
Smith et al. (2006) BRAD, Social Norms & Info (1)		-0.21 (-0.52, 0.09)
Glassman et al. (2010a) Risk Reduction & Social Norms		-0.09 (-0.30, 0.13)
Smith et al. (2006) BRAD, Social Norms & Info (2)		0.00 (-0.27, 0.28)
Hembroff et al. (2007) BRAD		0.06 (-0.10, 0.22)
Glassman (2010b) Social Norms & Risk Reduction		0.08 (-0.09, 0.25)
Lewis et al. (2008) Personalized Normative Feedback		0.09 (-0.20, 0.38)
Neighbors et al. (2009) Web-based Personalized Feedback		0.10 (-0.13, 0.34)
Neighbors et al. (2012) 21 WEB BASICS		0.17 (-0.11, 0.45)
LaBrie et al. (2009) Birthday Card		0.48 (-0.01, 0.98)
Overall (I-squared = 7.2%, p = 0.375)		0.05 (-0.03, 0.13)

Favors Control   Favors Intervention

Figure 2.
Forest plot of birthday intervention effects (relative to comparison) on quantity of alcohol consumed during 21st birthday celebration. Note that each effect size was estimated on a unique participant sample. Weights are from random effects analysis.

Study		Hedges' g (95% CI)

Neighbors et al. (2005) Birthday Card — 0.03 (-0.28, 0.34)

Lewis et al. (2008) Personalized Normative Feedback — 0.10 (-0.18, 0.39)

Neighbors et al. (2009) Web-based Personalized Feedback — 0.25 (0.01, 0.48)

Neighbors et al. (2012) 21 WEB BASICS — 0.25 (-0.04, 0.53)

LaBrie et al. (2009) Birthday Card — 0.54 (0.04, 1.03)

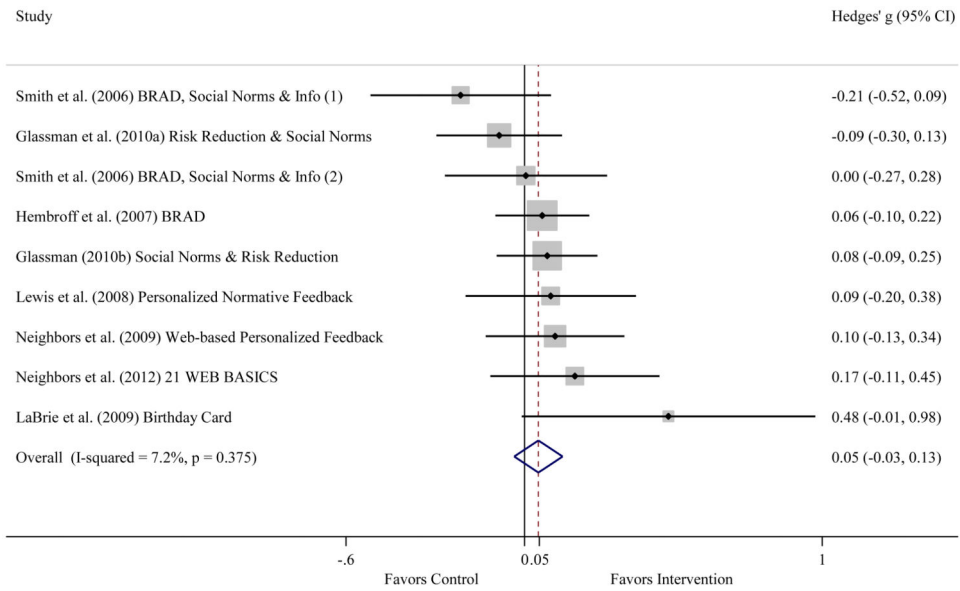Overall (I-squared = 0.0%, p = 0.450) — 0.20 (0.07, 0.33)

-.3   0   .2   1.05
Favors Control   Favors Intervention

Figure 3.
Forest plot of birthday intervention effects (relative to comparison) on blood alcohol concentration during 21st birthday celebration. Note that each effect size was estimated on a unique participant sample. Weights are from random effects analysis.
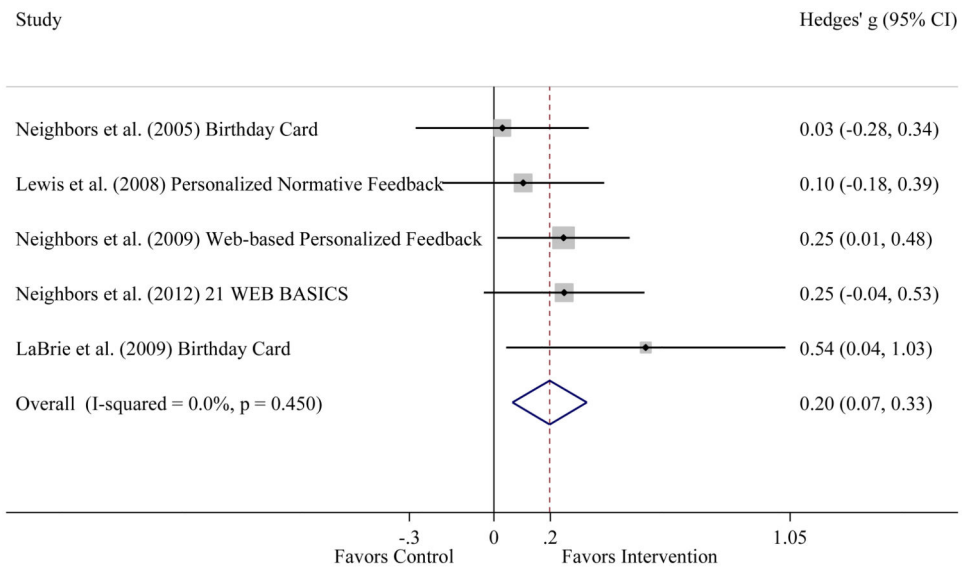
Table 1

Summary Description of Studies Included in the Meta-analysis

Authors	Year	Region	Tx n	Ct n	M %	White %	Administration mode and format	Groups analyzed	Ct type	Intervention components	Additional groups included in study but excluded from meta-analysis[a]
										Intervention Details	
Glassman et al.	2010	S	159	188	34	73	Electronic card	Combo (Risk Reduction + Social Norms)	DT	Alcohol education, alcohol consumption alternatives, social norms message, moderation strategies.	Study also included risk reduction and social norms groups
Glassman	2010	S	258	280	34	67	Electronic card	Combo (Risk Reduction + Social Norms)	NT	Alcohol education, alcohol consumption alternatives, social norms message, moderation strategies.	Study also included social norms and risk reduction groups
LaBrie et al.	2009	W	33	41	31	nd	Campus-mail card	Birthday Card	NT	Moderation strategies, alcohol consumption alternatives, social normative information.	
Lewis et al.	2008	MW	90	97	35	94	Mailed card	Personalized normative feedback card	NT	Normative reference message and feedback, BAC info.	
Hembroff et al.	2007	MW	479	227	46	nd	Mailed card	B.R.A.D. only	NT	Story of a student who died during his 21st birthday celebration, info about signs and symptoms of alcohol poisoning.	Study also included groups that received additional gender specific or gender neutral alcohol poisoning information
Neighbors et al.	2005	MW	78	86	38	96	Mailed card	Birthday Card	NT	Advice to drink in moderation.	
Neighbors et al.	2009	W	144	139	58	61	Web-based card and feedback	Web-based personalized feedback	NT	Normative feedback, BAC info, moderation strategies, info about negative alcohol consequences.	

Intervention Details

Authors	Year	Region	Tx n	Ct n	M %	White %	Administration mode and format	Groups analyzed	Ct type	Intervention components	Additional groups included in study but excluded from meta-analysis[a]
Smith et al.	2006	S	76	94	47	68	Mailed card	Combo 1 (B.R.A.D. + Info + Social Norms)	AT	Story of a student who died during his 21st birthday celebration, moderation and risk-reduction strategies, normative reference info.	Study also included B.R.A.D. card, information, and social norms groups
			100	107	41	74		Combo 2 (B.R.A.D. + Info + Social Norms)	AT		Study also included B.R.A.D. card, information, and social norms groups
Neighbors et al.	2012	W	96	95	46	68	Web-based feedback	21 Web-BASICS	NT	Normative reference info and feedback, BAC info, alcohol education.	Study also included other groups with face-to-face delivery format

Notes. Tx= treatment group; Ct= comparison group; n= sample size; M= male; S= South; W= West; MW = Midwest; nd= not determined; NT = no treatment comparison; DT = diluted treatment comparison; AT = attention treatment comparison;

[a] The most "comprehensive" intervention groups were selected for the main analysis for the alcohol quantity outcome to ensure the meta-analysis does not violate the assumption of statistically independent effect sizes. Sensitivity analyses were conducted with the excluded groups listed below to verify the robustness of the findings.

Table 2

Descriptive Statistics for the Characteristics of the Studies, Samples, and Interventions Included in the Meta-analysis

	M/%	k = 9 / g = 10	r
Study characteristics[a]			
Publication year (Mdn)	2008	9	0.33
Publication type (%) (1 = journal article; 0 = other)	80	9	-0.16
Region of the sample (%)		9	
Midwest	33		
South	33		
West	33		
Type of institution (%)		8	
Private (1=yes)	13		0.61
4 year	100		-
Size of institution (%) (0 = Small; 1 = Medium; 2 = Large)		9	-0.54
Small	11		
Medium	22		
Large	67		
Research design and implementation			
Randomized controlled trial (%)[a]	100	9	-
Randomization prior to approaching participants[a]	78	9	-0.34
Post-randomization attrition (%)[b]	47	10	-0.37
ITT analysis (%)[a]	56	9	0.06
CONSORT flow diagram included (%)[a]	22	9	0.34
Baseline data collected[b]	20	10	0.34
Comparison type (1 = no treatment; 0 = other)	70	10	0.73[*]
Sample characteristics (intervention groups)[b]			
% Male	41	10	0.03
% Greek-affiliated organization	17	2	-
% White	75	8	-0.07
% Black	11	5	-0.67
% Hispanic	11	2	-
Level of alcohol severity (%)		7	-0.16
Low-experimenters	14		
Medium-regular users	71		
Hazardous users	14		
Intervention characteristics[b]			
Intervention components (%)		10	
Advice	20		-0.21
Feedback	20		0.34

	M/%	k = 9 / g = 10	r
Norm referencing	80		-0.06
Education/information	50		-0.04
Campus/proximal feedback	40		0.04
Information about negative consequences	40		-0.05
BAC information/feedback	10		0.17
Delivered in print via mail (vs. electronic) %	80		-0.34
Time of intervention delivery (Mean days prior to birthday)	6	9	-0.56

Notes. k = number of studies providing data; g = number of intervention groups data;

[a] Estimates calculated at study level;

[b] Estimates calculated at intervention group level; *r* = bivariate correlation between study characteristic and effect sizes for alcohol quantity outcomes; correlations not estimated when fewer than 4 studies contributed information or no variability in variable distribution.

[*] = p< 0.05

Table 3

GRADE Summary of the Quality of the Body of Evidence for Each Outcome

Outcomes	Source of data (M FUP)	Illustrative comparative risks[a] (95% CI)		No of participants (Studies)	GRADE[b] quality of the evidence
		Comparison (Assumed risk)	BAIs (Corresponding risk)		
Quantity of alcohol consumed	Self-report (7 days)	Mean 7 standard drinks	Mean 0.05 SD lower (0.13 lower to 0.03 higher)	2703 (9 studies)	very low[1,2]
BAC	Self-report (7 days)	Mean 0.15 BAC	Mean 0.20 SD lower (0.33 lower to 0.07 higher)	899 (5 studies)	very low[1,3]

Notes. M FUP = Mean Follow-up timing; CI = Confidence Interval; SD = Standard Deviation; BAI = Brief Alcohol Intervention

[a]The basis for the assumed risk (e.g. the median comparison group risk across studies) is provided in footnotes. The corresponding risk (and its 95% CI) is based on the assumed risk in the comparison group and the relative effect of the intervention (and its 95% CI).

[b]GRADE Working Group grades of evidence: High quality = Further research is very unlikely to change our confidence in the estimate of effect; Moderate quality = Further research is likely to have an important impact on our confidence in the estimate of effect and may change the estimate; Low quality = Further research is very likely to have an important impact on our confidence in the estimate of effect and is likely to change the estimate; Very low quality = We are very uncertain about the estimate.

[1]A substantial majority of data is at high risk of detection and attrition bias.

[2]All confidence intervals include important effects and no effects at all, including important negative and positive effects.

[3]This is a main outcome for this intervention and this review, but only 56% of studies are included in this analysis.