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Web-Based Alcohol Prevention for Incoming College Students: A Randomized Controlled Trial

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Abstract

College students are an at-risk population based on their heavy alcohol consumption and associated consequences. First-year students are at particular risk due to greater freedom and access to alcohol on campus. Web-based (electronic) interventions (e-interventions) are being rapidly adopted as a universal approach to prevent high-risk drinking, but have not been well evaluated. The objective of this study was to investigate the effectiveness of the two most widely adopted EIs, AlcoholEdu and The Alcohol eCHECKUP TO GO (e-Chug), in reducing both alcohol use and alcohol-related consequences in incoming college students. To do so, we conducted a 3-group randomized trial ($N = 82$) comparing AlcoholEdu and e-Chug to an assessment-only control group. Compared to the assessment-only control group, participants in the AlcoholEdu and e-Chug groups reported lower levels of alcohol use across multiple measures at 1-month follow up. Participants who received AlcoholEdu showed significantly fewer lower alcohol-related consequences than assessment-only controls, while there was a trend for reduced consequences in participants who received e-Chug versus assessment-only. Findings indicate that e-intervention is a promising prevention approach to address the problem of college student alcohol consumption, especially for campuses that have limited resources.

Keywords

alcohol use; alcohol problems; college students; internet intervention; alcohol education; personalized feedback

1. Introduction

College student alcohol use is a major public health concern (U.S. Department of Health and Human Services, 2000). Large-scale surveys indicate that approximately 68% of all college students drank alcohol in the past month (Johnston, O'Malley, Bachman, & Schulenberg, 2006), and approximately 40% of all college students engage in heavy episodic drinking, defined as consumption of 5 or more drinks for men (4+ for women) in one drinking episode

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during the past 2 weeks (Wechsler, Dowdall, Davenport, & Rimm, 1995). Heavy episodic alcohol consumption in college students is related to numerous consequences, including academic difficulties, property damage, risky sexual activity, blackouts, alcohol poisoning, and death (Hingson et al., 2002; Jackson et al., 2005; Wechsler & Isaac, 1992). Recent reports indicate that college drinking has not decreased over the past decade (Johnston et al., 2006), and cross-sectional data evidenced a 16% increase in the proportion of students who engage in frequent heavy episodic alcohol use (≥ 3 in the past two weeks) between 1993 and 2001 (CASA, 2007). The first year of school is a particularly risky period, and many first-year college students develop a pattern of heavy drinking that puts them at risk for adverse consequences (see Borsari, Murphy, & Barnett, 2007).

Campus administrators have increased efforts to devise and implement prevention programs that minimize high-risk drinking (Wechsler et al., 2002), but individual and group prevention sessions are costly and require considerable staff effort to deliver. Because of their broad reach and low administrator burden, web-based (electronic) interventions (EIs) have been adopted as a promising universal approach to prevent high-risk drinking. Recent technological advances, including increased access to the internet and faster internet connections, have resulted in greater incorporation of electronic methods of communication (email, streaming video, interactive programs) into interventions (see Walters, Wright, & Shegog, 2006 for review). EIs for behavior change show promising results for alcohol use and dependence (Hester, Squires, & Delaney, 2005; Neighbors, Lee, Lewis, Fossos, & Walter, 2009), smoking cessation (Saitz et al., 2007), mental health conditions (Christensen, Griffiths, Mackinnon, & Brittliffe, 2006; Griffiths & Christensen, 2006), and physical activity (Napolitano et al., 2003).

We are aware of six commercial web-based EIs targeting college student alcohol use: (1) Under the Influence, (2) Alcohol Response-Ability, (3) myStudentBody, (4) College Alc, (5) AlcoholEdu (Outside the Classroom) and (6) The Alcohol eCHECKUP TO GO (e-Chug). Programs vary in scope and length, but all of these e-interventions provide normative drinking information, protective strategies (e.g., tips for safer drinking), and alcohol education. Although educational strategies do not appear to be an effective prevention strategy when used alone (Goodstadt & Caleekal-John, 1984), other components used by these interventions have evidence of effectiveness with heavier drinking college students, including cognitive-behavioral skills, normative drinking information, and motivational information (Larimer & Cronce, 2002, 2007).

1.1. Efficacy of e-interventions

In the first controlled evaluation of an e-intervention for college student alcohol use, myStudentBody, a multimedia health educational website incorporating motivational enhancement strategies, was evaluated in a sample of 265 students from five campuses in the northeast (Chiauzzi, Green, Lord, Thum, & Goldstein, 2005). In the study, participants were randomly assigned to receive access to myStudentBody or educational literature. Students who received myStudentBody demonstrated a steeper reduction in alcohol use and consequences 1 month after receiving access to the website than students in the comparison group, but no differences in consumption or alcohol-related consequences were found at 3-month follow up.

College Alc is a 75-minute EI that uses multimedia video clips, illustrations, and static text to present educational information about the physiological effects of alcohol, descriptive alcohol norms, high-risk behaviors (e.g., drinking and driving), and safer drinking strategies. College Alc was evaluated in a sample of college freshman ($N = 370$) who were randomized to College Alc or an assessment-only control group (Paschal, Bersamin, Fearnow-Kenney, Wyrick, & Currey, 2006). Results indicated that students assigned to College Alc showed increased knowledge about alcohol, fewer positive attitudes about alcohol use, and higher intentions to

use safer drinking strategies relative to the control group at the end of the first semester in college. However, no differences in alcohol use, alcohol expectancies, normative beliefs, or negative alcohol-related consequences were observed.

In a supplemental analysis of College Alc using the same sample, students in the College Alc group who reported drinking within 30 days of the baseline survey showed decreases in heavy episodic drinking, drinking to the point of intoxication, and alcohol-related consequences, while drinkers in the control group reported increases for each of these outcomes (Bersamin, Paschall, Fearnow-Kenney, & Wyrick, 2007). However, the generalizability of these findings is unknown, given the low initial response rate (16%), low treatment adherence (only 48% of the participants completed the entire College Alc curriculum), and follow up rate (59%).

AlcoholEdu and e-Chug have received more systematic evaluation. AlcoholEdu is a 3-hour educational program that utilizes multimedia presentations and static text within three content areas. The first content area (“Shaping our Decisions”) focuses on social pressures, injunctive alcohol norms, alcohol advertising, and biopsychosocial consequences of heavy episodic drinking. The second content area (“Knowing the Facts”) provides information about the physiological effects of alcohol and alcohol expectancies. The final section (“When it Matters”) provides tips and suggestions about how to be safer when drinking. The program blends text-based information, streaming video, and interactive web pages.

In a non-experimental and retrospective evaluation of the 2003 version of AlcoholEdu, college students from 225 campuses who completed AlcoholEdu between 2003–2004 were randomly assigned to an intervention or comparison group within 4-week blocks (Wall, 2007). Baseline alcohol use and alcohol-related consequences for the comparison group were compared to the intervention group’s post-test alcohol use and alcohol-related consequences ($N = 24,877$; 7.3% incoming freshman, 92.7% matriculated). Results indicated that the intervention group reported fewer heavy episodic drinking episodes and alcohol-related consequences than the comparison group. Interpretation of the findings of this study is limited because only students who completed the post-test assessment were included in the analyses (49.5% of the sample).

More recently, a randomized controlled trial (RCT) was conducted to evaluate the efficacy of AlcoholEdu (Croom et al., 2009). In this study, incoming students ($N = 3,216$) were randomized to the 2006 version of AlcoholEdu or a waitlist control group. Participants were 1,891 students (a 57% response rate) who completed the baseline and 1-month follow-up assessment. Results indicated that students who received AlcoholEdu reported playing drinking games less frequently than the control group at follow up, and endorsed more correct answers on the AlcoholEdu knowledge exam than the control group at follow up. However, groups did not differ according to the amount of alcohol consumed during a typical week. No differences were found at follow up for other risky behaviors (e.g., drinking shots, engaging in heavy episodic drinking, pre-gaming), safer drinking behaviors (e.g., eating before drinking, alternating alcoholic beverages with non-alcoholic drinks), or high-risk outcomes (e.g., hangovers, alcohol induced memory loss, one-night stands). Limitations of this study include high levels of attrition (40%) and a randomization procedure that failed to produce equivalent groups at baseline for past alcohol education exposure, alcohol knowledge, readiness to change, and parental discussions about drinking. However, because AlcoholEdu is regularly revised, these results may not generalize to newer versions of AlcoholEdu.

In a second RCT of AlcoholEdu, freshman students ($N = 1,620$) were assigned to the 2007 version of AlcoholEdu ($n = 810$) or an assessment-only control group ($n = 810$) at the start of the Fall semester (Lovecchio, Wyatt, & DeJong, in press). One follow up was conducted 30 days after baseline, and this survey was completed by 92% of the AlcoholEdu group and 68% of the control group. Results indicated that the AlcoholEdu group consumed less alcohol than

the control group at the 1-month follow-up. In addition, the AlcoholEdu group reported experiencing fewer negative alcohol-related consequences at follow up than the control group. A limitation of this study is that participants who failed to complete the follow-up were lighter drinkers at baseline than completers. Although baseline alcohol use was used as a covariate in the data analysis, it is possible that the differential rate of attrition may have affected the findings.

e-Chug is the briefest alcohol EI currently available for college students (approximately 20 minutes to complete). This EI provides students personalized normative feedback (PNF) using text and illustrations to present the amount of alcohol consumed, caloric intake from alcohol use, gender-specific alcohol normative information, estimated annual monetary cost of the alcohol consumed, estimated BAC, tolerance, and negative alcohol-related consequences. e-Chug also presents three short videos (approximately 3 minutes) about standardized drink definitions, BAC, and the biphasic response curve. The last section of e-Chug contains a list of safer drinking strategies and a referral list of local and national resources.

e-Chug has been evaluated in two separate RCTs as an indicated intervention for heavier drinking college students (Walters, Vader, & Harris, 2007) and as primary prevention for first-year students (Doumas & Andersen, 2009). In Walters et al., freshmen ($N = 106$) from a large public university who reported at least one heavy episodic drinking episode in the past month were randomly assigned to e-Chug or an assessment-only condition. Assessments were completed at baseline, 2, and 4 months. Results indicated that students who received e-Chug demonstrated a steeper reduction in alcohol use at the 2-month follow up compared to the control group, but the groups did not differ in alcohol consequences, and no significant differences were found at the 4-month follow up. These results from the heavy drinking students are consistent with a growing body of research that indicates that the mechanism of PNF delivery (e.g., standalone, mailed, or internet-delivered) is not related to superior treatment outcomes (see White, 2006 for review). Although this study primarily targeted heavy drinking college students, lower-risk drinkers (abstainers and light drinkers, $N = 245$) were also randomized to conditions, but no significant differences in alcohol consumption were observed between groups for these lighter drinkers.

Doumas and Anderson (2009) evaluated the efficacy of e-Chug in a sample of freshman students who were recruited from six first-year college seminar sections. Participants ($N = 80$, response rate 92%) were randomized to e-Chug or assessment-only by section and they completed a baseline assessment. These participants were classified as high-risk or low-risk based according to whether they reported engaging in at least one heavy episodic drinking episode in the past two weeks. Participants were recontacted after 3 months and 65% ($n = 52$) completed the follow-up assessment. Results indicated that high-risk drinkers who received e-Chug reported drinking less alcohol and fewer alcohol-related consequences than the comparison group at follow up. Low-risk drinkers in both groups were not significantly different for alcohol use and related consequences at follow up. One limitation of this study is that participants who completed the follow-up assessments reported experiencing significantly fewer alcohol-related consequences at baseline than those who did not complete the follow-up. Although there is strong evidence for PNF as an indicated intervention and primary prevention for already enrolled first-year students, PNF, and specifically e-Chug, has not been evaluated as a universal prevention program for incoming students.

The purpose of the present study was to conduct an evaluation of the two most highly adopted EIs used as universal prevention for incoming college students. We decided to evaluate these programs with incoming students because EIs are commonly administered during this high-risk transition from high school to college, before students have increased access to alcohol and decreased parental monitoring. As even minimal PNF has been found to reduce alcohol

use, we expected that students who received AlcoholEdu or e-Chug would report lower levels of alcohol use and alcohol-related consequences at follow up than assessment-only controls. In addition, we expected that the more comprehensive information presented in AlcoholEdu would be more effective with incoming students than PNF, so we expected that students who received AlcoholEdu would report lower levels of alcohol use and alcohol-related consequences at follow up than students who completed e-Chug.

2. Method

2.1. Setting

The project was conducted at a four-year, private liberal arts university located in the Northeast. The school has approximately 4,000 undergraduates (15% minority, 51% female). First-year students primarily live on campus, and there are no fraternities or sororities. All procedures were approved by the University Institutional Review Board.

Participants and Recruitment—Participants were recruited from the incoming freshman class before the start of the fall semester, 2008. Approximately three weeks prior to the first day of classes, 150 randomly sampled incoming students received an invitation letter with a brief description of our study and a notice that two weeks prior to starting college they would receive an email invitation that would allow them to enroll in the project. Incoming students at this university are required by the administration to complete AlcoholEdu prior to moving into the dorms, so students were informed that joining the study and completing the assigned condition would meet this university requirement. Students were eligible to participate if they were 18-years-old or older, and a first-time college student (non-transfer student) who attended a high school in the United States. The email invitation contained an introduction to the study and informed consent pages. Students indicated their consent to participate by clicking a survey item that stated “Yes, I understand and want to participate in this study.”

Following consent, participants completed the baseline survey online (approximately 30 minutes). After submitting their baseline survey they were immediately notified of their condition (all recruited students were randomized to one of three conditions prior to recruitment using a random number generator). Instructions directed participants to the intervention website or (in the case of the assessment-only control group) informed them that they would next receive contact from the study for the 1-month follow up assessment. Researchers were informed by the EIs when/if participants completed the interventions. Participants had approximately two weeks to complete the baseline assessment and intervention prior to moving to campus.

Participants were sent an email link to the follow-up survey after they had been on campus for 30 days. Participants were given two weeks to complete the follow up, and nonresponders received up to 3 reminder emails and 3 phone calls. Participation in this study fulfilled the campus requirement to complete the mandated prevention program and participants received \$15 for completing each of the baseline and follow up surveys.

2.2. Measures

Baseline and follow up assessments were completed online using Illume 4.0 (DatStat, Inc.). The technology for transmitting and storing data included 128-bit secure sockets layer (SSL) encryption, and firewalls to protect the data and to prevent unauthorized access.

2.2.1. Demographics—This survey recorded date of birth, gender, ethnicity, place of residence (e.g., on campus dormitory), and weight.

2.2.2. Typical week alcohol consumption—Participants reported the number of standard drinks of alcohol consumed on each day of the week for what they considered to be a typical week of alcohol consumption during the past 30 days.

2.2.3. Heavy episodic drinking—Participants were asked to report the number of times that they engaged in heavy episodic drinking in the past 30 days using gender-specific cut-scores (4+ drinking for women, 5+ for men in a 2-hour period) (National Institute on Alcohol Abuse and Alcoholism, 2002).

2.3.4. Typical and peak alcohol consumption—This questionnaire assessed the number of standard drinks consumed in a typical and heavy drinking occasion over the past 30 days (Borsari & Carey, 2005). Participants reported the amount of time spent drinking during these episodes, which was used to estimate typical and peak BAC (Matthews & Miller, 1979).

2.3.5. Alcohol-related consequences—The Young Adult Alcohol Consequences Questionnaire (YAACQ; Read, Kahler, Strong, & Colder, 2006) is a 48-item inventory of alcohol-related consequences (answered yes/no) developed specifically for college students. Unlike previous one-dimensional inventories for alcohol-related consequences, this measure has multiple subscales. Factor analysis of the YAACQ derived eight factors: social-interpersonal (e.g., “while drinking, I have said or done embarrassing things”), impaired control (e.g., “I often have found it difficult to limit how much I drink”), self-perception (e.g., “I have felt badly about myself because of drinking”), self-care (e.g., “I haven’t been as sharp mentally because of my drinking”), risky behavior (e.g., “I have taken foolish risks when I have been drinking”), academic/vocational difficulty (e.g., “I have received a lower grade on an exam or paper than I ordinarily would have because of my drinking”), physical dependence (e.g., “I have felt anxious, agitated, or restless after stopping or cutting down on my drinking”), and blackout drinking (e.g., “I’ve not been able to remember large stretches of time while drinking”) (Read et al., 2006). We used a 30-day window at baseline and follow up.

2.4. EIs and Assessment-only Control Group

Participants were informed that they were required to complete the baseline assessment and EI, if assigned, up to two days before moving into the campus dormitories. Participants who did not complete baseline ($n = 1$) by this deadline were not included in the study.

2.4.1. AlcoholEdu—This program was not altered in any way for our study. Participants accessed the program through the AlcoholEdu website. Students completed an online assessment that is part of AlcoholEdu prior to the start of this prevention program, and a post-test alcohol knowledge questionnaire at the end of the program.

2.4.2. e-Chug—This program was not altered in any way. Participants accessed the program through the e-Chug website using the information we provided. Participants in the e-Chug condition were first asked to complete a brief online assessment from which e-Chug produces immediate PNF. Participants in the e-Chug condition had an opportunity to print their seven-page PNF.

2.4.3. Assessment-only control—Participants in the control condition received no intervention. The only contact consisted of email and telephone reminders to complete the follow up assessment. Participants in this group were excused from the requirement by the university’s administration to complete AlcoholEdu. Instead, they were given a choice of using either AlcoholEdu or e-Chug after the 1-month follow-up assessment.

2.5. Data Analysis Plan

MANCOVA, controlling for baseline values and gender, was used to investigate group differences in seven variables: (1) typical week drinking, (2) frequency of heavy episodic drinking, (3) number of drinks consumed on a typical day, (4) number of drinks on a peak day of drinking, (5) estimated typical blood alcohol concentration (BAC), (6) estimated peak BAC, and (7) negative alcohol-related consequences. Significant omnibus tests were followed by planned comparisons to investigate differences between groups. Between-group and within-group effect sizes were obtained using Cohen's *d* (using pooled standard deviations), where 0.2 is classified as a small effect, 0.5 is a medium effect, and 0.8 is a large effect (Cohen, 1988). A positive effect size indicated a mean decrease in behaviors for the comparison group (AlcoholEdu or e-Chug) relative to the reference group (Control or e-Chug). All analyses were conducted using PASW Statistics 17.0 (SPSS Inc, 2009).

3. Results

3.1. Sample Characteristics

Of the 150 students invited to participate, 39 students did not respond to our survey, 12 of which were not eligible to participate (6 did not matriculate and 6 were younger than 18-years-old). A total of 111 students opened the email invitation to the survey. Of these 111 students, 15 students were not eligible because they were minors, and 13 did not consent to participate. Out of the 83 eligible students who consented, 82 completed the baseline assessment. Consequently, 82 (67%) of the presumed 123 eligible students consented to participate and were randomized to assessment only ($n = 25$; 30.5%), e-Chug ($n = 31$; 37.8%), or AlcoholEdu ($n = 26$; 31.7%).

Participants were 51% female, and 89% Caucasian, with a mean age of 18.10 ($SD = 0.30$). The e-Chug group had a higher proportion of male participants (64.5%) than the AlcoholEdu group (38.5%; $z = 1.96$, $p = .05$). There were no other group differences on gender, race, or age. All but one participant completed the EI condition as assigned (in this case, e-Chug) and one participant in the control group did not complete the follow up (a 98% follow-up rate). On average, participants completed the follow-up survey 43.2 ($SD = 5.7$) days after the baseline assessment.

3.2. Preliminary Analyses

Outcome variables were examined for skew and kurtosis. The distribution for all outcome variables deviated from the normal distribution (> 2 skew and > 4 kurtosis) so a square-root transformation was used to normalize the multivariate distributions (Tabachnick & Fidell, 1996). Raw descriptive statistics for the outcome variables across assessments are in Table 1. Groups were not significantly different across outcome variables at baseline ($ps > .05$), suggesting that the randomization procedures were successful. Although there were no significant baseline differences, we covaried baseline scores for each outcome variable.

3.3. Outcome Analyses

Intervention group differences were detected across each of the seven outcomes (i.e., typical drinks per drinking occasion, peak drinks, average number of drinks per week, number of heavy drinking episodes, typical BAC, peak BAC, and alcohol-related consequences; $V = .35$, $F(14, 126) = 1.90$, $p < .05$; see Table 1). The univariate tests for alcohol use variables indicated that there were group differences for typical drinks per drinking occasion ($F[2, 68] = 6.76$; $p \leq .01$), peak drinks ($F[2, 68] = 10.21$, $p \leq .001$), average number of drinks per week ($F[2, 68] = 12.52$, $p \leq .001$), number of heavy drinking episodes ($F[2, 68] = 8.25$, $p \leq .001$), typical BAC ($F[2, 68] = 4.80$, $p \leq .05$), and peak BAC ($F[2, 68] = 9.99$, $p \leq .001$). Planned comparisons for

the alcohol use variables indicated that the AlcoholEdu and e-Chug group had lower alcohol use involvement across all outcome variables at the follow-up than assessment-only controls ($ps < .05$). Drinking outcomes at follow up were not significantly different for alcohol use variables between the e-Chug and AlcoholEdu groups. Between-group effect sizes (Cohen's d using estimated means adjusted for gender and baseline values) are presented in Table 2; 1-month effect sizes ranged across the seven outcomes from .59 to .75 ($Mdn = .68$) for AlcoholEdu versus controls, .54 to .85 ($Mdn = .61$) for e-Chug versus controls, and $-.11$ to .13 ($Mdn = .02$) between e-Chug and AlcoholEdu. Within-group effect sizes at 1 month for alcohol use variables ranged from $-.21$ to .18 ($Mdn = .01$) for AlcoholEdu and $-.24$ to .33 for e-Chug ($Mdn = -.04$), versus $-.55$ to $-.78$ ($Mdn = -.65$) for the assessment-only condition.

The univariate test for alcohol-related consequences experienced during the first 30 days at college indicated that there was a trend for differences between groups, $F(2, 68) = 2.74, p = .07$. Planned comparisons indicated that participants who received AlcoholEdu reported fewer alcohol-related consequences at follow up than assessment only controls ($p < .05$). There was a trend for the e-Chug group to report fewer consequences than assessment-only controls at follow-up ($p = .09$), and AlcoholEdu did not differ from e-Chug. To investigate the magnitude of these group differences at the 1 month follow-up, we calculated between-group effect sizes (Table 2). The effect size between the EIs and the control group were in the small to medium range for e-Chug ($d = .34$) and AlcoholEdu ($d = .56$). The effect size between the two EIs at 1 month was .20. Within-group effect sizes at 1 month for alcohol-related consequences were .32 for AlcoholEdu and .08 for e-Chug, versus $-.26$ for the assessment-only condition.

In light of the significant difference between AlcoholEdu and assessment-only controls, and the marginally significant difference between e-Chug and assessment-only controls, exploratory analyses were conducted to investigate differences in each of the eight YAACQ subscales between EI conditions and assessment-only controls using MANCOVA, controlling for gender and baseline values. The omnibus multivariate test failed to detect differences between groups across all subscales ($V = .24, F[16, 124] = 1.06$). Because we were primarily interested in exploring differences between groups for each subscale, the multivariate tests were followed by univariate tests. The univariate tests for alcohol use variables detected group differences in social-interpersonal ($F[2, 68] = 4.73; p \leq .05$), impaired control consequences ($F[2, 68] = 4.55, p \leq .05$), self-perception ($F[2, 68] = 3.73, p \leq .05$), but not self-care ($F[2, 68] = .57$), risk behaviors ($F[2, 68] = 1.30$), academic/occupational consequences ($F[2, 68] = 0.70$), physical dependence ($F[2, 68] = 1.77$), and blackout drinking ($F[2, 68] = 1.42$). Significant univariate tests were followed by planned comparisons that indicated that both the AlcoholEdu and e-Chug group reported fewer social-interpersonal ($ps \leq .05$) and impaired control consequences ($ps < .001$) than the assessment only controls at the 1-month follow-up. In addition, the AlcoholEdu group reported fewer self-perception consequences at follow up than the assessment only controls ($ps \leq .02$). EI groups did not differ in these subscales at follow up.

4. Discussion

This is the first controlled study to simultaneously evaluate the effectiveness of AlcoholEdu and e-Chug when used as prevention for incoming students. Consistent with our expectation, the AlcoholEdu and e-Chug groups reported less alcohol use at follow up than the control group. On average, students in both EI groups reported decreased or stable alcohol use involvement post-baseline for several outcomes, while the control group reported increased alcohol use for all outcomes. For example, participants in the control group nearly doubled their estimated peak BAC (from 0.07 g/dL at baseline to 0.15 g/dL at follow up), while students in both EI groups had average estimated peak BACs of 0.08 g/dL at both assessments. Consistent with these findings, participants in both EI groups decreased the number of harms

associated with their drinking at follow up, while students in the control group showed an increased number of consequences. However, only the AlcoholEdu group was significantly different from the control group for alcohol-related consequences.

Exploratory analyses were conducted to investigate group differences in the types of consequences reported. To our knowledge, this is the first examination of differences in *subtypes* of alcohol-related consequences across intervention groups. We were able to do so because alcohol-related consequences in this study was measured using the YAACQ, a relatively new measure that has multiple subscales, unlike previous one-dimensional inventories for alcohol-related consequences. Investigating differences in subtypes of alcohol-related consequences may help inform how alcohol interventions work. In this study, students in both EI groups reported significantly lower levels of alcohol-related harms associated with interpersonal problems and difficulty with controlling their alcohol use than the control group. The AlcoholEdu group also reported significantly lower levels of regret about previous drinking occasions than the control group at follow up. It is possible that AlcoholEdu was slightly more effective at reducing the harms associated with drinking because it provides more effective information about safer-drinking and problem-solving strategies for high-risk drinking situations than e-Chug.

These results have strong clinical implications for primary prevention of risky-drinking in college students. Findings from this study suggest that interventions delivered prior to college can be helpful at reducing short-term alcohol use and the related consequences. Reductions in alcohol use during the first few weeks of college may be extremely important, because it is speculated that the first few weeks on campus are imperative to future success in college (NIAAA, 2002). Not only was AlcoholEdu effective at reducing alcohol use and alcohol-related consequences during this critical juncture, but this program was also beneficial because it provided an opportunity for all matriculating students to receive similar information about alcohol and its effects. In addition, e-Chug was effective at reducing alcohol use behaviors and provides students with information that is typical delivered in a face-to-face brief motivational interview. Therefore, these programs may greatly reduce the role of student naïveté and inexperience in alcohol use behaviors. This foundation of knowledge could also facilitate more insightful and sophisticated conversations with peers, parents, and faculty members, as well as counselors who provide high-risk students with additional alcohol intervention.

Our results can be placed in context with other research on the efficacy of AlcoholEdu. Our results on the efficacy of AlcoholEdu for minimizing the normative developmental increase in alcohol use involvement during the start of the freshman year are generally consistent with Lovecchio et al. (in press) who found that the AlcoholEdu group showed decreased alcohol use relative the control group at follow up. However, these findings are discrepant from Croom et al. (2009), who found no differences between the AlcoholEdu and assessment-only groups at follow-up. One potential explanation for these discrepancies is that Croom and colleagues evaluated an older version of AlcoholEdu, while Lovecchio et al. and our investigation evaluated a more recent version (2007 and 2008, respectively). Since EIs are revised on a regular basis, it will be important, but challenging, to monitor their effectiveness over time.

4.1. Strengths and limitations

This study had a number of strengths, including good compliance and retention rates that help bolster our confidence in the external validity of these results. Another strength of our study is that the EIs were not modified, and therefore generalizability is high. However, both AlcoholEdu and e-Chug include assessment questions administered prior to the intervention, and these questions overlapped with questions in our baseline survey. The survey responses within the EIs are used to provide tailored feedback, so eliminating the questions within the EIs was not an option. The research assessment battery also was necessary to evaluate the

experimental manipulation adequately. Thus, the evaluation was of the two EIs plus two assessments versus assessment only. There is evidence that assessments affect later reports of alcohol use (e.g., Carey, Carey, Maisto, & Henson, 2006), so future studies that blend the baseline assessments into the EI and/or evaluate the degree of assessment reactivity are needed.

Several other limitations are worth mentioning. First, participants in this study were primarily Caucasian students who were enrolled at a private liberal arts college in the Northeast that required all incoming students to take an EI. Therefore, results from this study may not generalize to other EIs, racial groups and US universities. Second, students were randomized to conditions, but it is possible that contamination between conditions occurred when students relocated to college. Third, although there is no research to suggest that drinking patterns differ between incoming students who are 17 years old and those who are at least 18 years old, results from this study may not generalize to incoming students who are under 18 years old. Finally, although self-reported alcohol consumption is generally considered valid with college students (Borsari & Muellerleile, 2009), it is possible that students in the EI conditions responded to the messages in the EIs by providing more socially acceptable responses.

4.2. Future Directions

Additional research is needed to further evaluate EIs for college student drinkers using larger and more diverse samples with longer follow ups. In addition, because PNF interventions have been found to be efficacious for heavy drinking college students, it is conceivable that e-Chug would be more effective if students were asked to complete e-Chug after starting college when college student drinking norms would be more relevant. Finally, an increasing number of colleges require students to complete an alcohol prevention program before college starts, early in the fall semester or before the spring semester. Future studies are needed to investigate whether EIs are more effective when they are administered before matriculation than when administered later in the academic year.

4.3. Conclusions

These results add to a growing body of literature that indicates that web-based interventions that incorporate techniques with evidence of effectiveness (i.e., cognitive-behavioral skills, normative drinking information, and motivational information) with heavy drinking college students can also be effective at reducing alcohol use and alcohol-related harms in first-year college students. Given the results supporting the efficacy of EIs, and the low administrative burden to deliver EIs, web-based alcohol-education programs like AlcoholEdu and e-Chug appear to be a promising approach to reduce alcohol use in freshmen college students.

References

- Bersamin M, Paschall MJ, Fearnow-Kenney M, Wyrick D. Effectiveness of a Web-based alcohol-misuse and harm-prevention course among high- and low-risk students. *Journal of American College Health* 2007;55:247–254. [PubMed: 17319331]
- Borsari B, Carey KB. Two brief alcohol interventions for mandated college students. *Psychology of Addictive Behaviors* 2005;19:296–302. [PubMed: 16187809]
- Borsari B, Muellerleile P. Collateral reports in the college setting: A meta-analytic integration. *Alcoholism: Clinical & Experimental Research* 2009;33:826–838.
- Borsari B, Murphy JG, Barnett NP. Predictors of alcohol use during the first year of college: Implications for prevention. *Addictive Behaviors* 2007;32:2062–2086. [PubMed: 17321059]
- Carey KB, Carey MP, Maisto SA, Henson JM. Brief motivational interventions for heavy college drinkers: A randomized controlled trial. *Journal of Consulting and Clinical Psychology* 2006;74:943–954. [PubMed: 17032098]

- CASA (Center on Addiction and Substance Abuse). Wasting the best and brightest: Substance abuse at America's colleges and universities. 2007
- Chiauzzi E, Green TC, Lord S, Thum C, Goldstein M. My student body: A high-risk drinking prevention web site for college students. *Journal of American College Health* 2005;53:263–274. [PubMed: 15900990]
- Christensen H, Griffiths KM, Mackinnon AJ, Brittliffe K. Online randomized controlled trial of brief and full cognitive behaviour therapy for depression. *Psychological Medicine* 2006;36:1737–1746. [PubMed: 16938144]
- Cohen, J. *Statistical power analysis for the behavioral sciences*. 2nd ed.. Hillsdale, NJ: Lawrence Erlbaum Associates; 1988.
- Croom K, Lewis D, Marchell T, Lesser ML, Reyna VF, Kubicki-Bedford L, et al. Impact of an online alcohol education course on behavior and harm for incoming first-year college students: Short-term evaluation of a randomized trial. *Journal of American College Health* 2009;57:445–454. [PubMed: 19114384]
- Doumas DM, Andersen LL. Reducing alcohol use in first-year university students: Evaluation of a Web-based personalized feedback program. *Journal of College Counseling* 2009;12:18–32.
- Goodstadt MS, Caleekal-John A. Alcohol education programs for university students: A review of their effectiveness. *International Journal of Addictions* 1984;19:721–741.
- Griffiths KM, Christensen H. Review of randomised controlled trials of internet interventions for mental disorders and related conditions. *Clinical Psychologist* 2006;10:16–29.
- Hester RK, Squires DD, Delaney HD. The Drinker's Check-up: 12-month outcomes of a controlled clinical trial of a stand-alone software program for problem drinkers. *Journal of Substance Abuse Treatment* 2005;28:159–169. [PubMed: 15780546]
- Hingson RW, Heeren T, Zakocs RC, Kopstein A, Wechsler H. Magnitude of alcohol-related mortality and morbidity among U. S. college students ages 18–24. *Journal of Studies on Alcohol* 2002;63:136–144. [PubMed: 12033690]
- Jackson, KM.; Sher, KJ.; Park, A. Drinking among College Students. In: Galanter, M., editor. *Recent developments in alcoholism: Volume 17. Alcohol problems in adolescents and young adults*. New York, NY: Kluwer Academic/Plenum Publishers; 2005. p. 85-117.
- Johnston, LD.; O'Malley, PM.; Bachman, JG.; Schulenberg, JE. *Monitoring the Future national survey results on drug use, 1975–2005. Volume II: College students and adults ages 19–45*. Bethesda, MD: National Institute on Drug Abuse; 2006.
- Larimer ME, Cronce JM. Identification, prevention and treatment: A review of individual-focused strategies to reduce problematic alcohol consumption by college students. *Journal of Studies on Alcohol. Supplement* 2002;148–163. [PubMed: 12022721]
- Larimer ME, Cronce JM. Identification, prevention, and treatment revisited: Individual-focused college drinking prevention strategies 1999–2006. *Addictive Behaviors* 2007;32:2439–2468. [PubMed: 17604915]
- Lovecchio CP, Wyatt TM, DeJong W. Reductions in drinking and alcohol-related harms reported by first-year college students taking an online alcohol education course: A randomized trial. *Journal of Health Communication*. (in press).
- Matthews DB, Miller WR. Estimating blood alcohol concentration: two computer programs and their applications in therapy and research. *Addictive Behaviors* 1979;4:55–60. [PubMed: 420046]
- Napolitano MA, Fotheringham M, Tate D, Sciamanna C, Leslie E, Owen N, et al. Evaluation of an internet-based physical activity intervention: A preliminary investigation. *Annals of Behavioral Medicine* 2003;25:92–99. [PubMed: 12704010]
- National Institute on Alcohol Abuse and Alcoholism. *A call to action: Changing the culture of drinking at U.S. colleges*. Washington D.C.: National Institutes of Health; 2002.
- Neighbors C, Lee CM, Lewis MA, Fossos N, Walter T. Internet-based personalized feedback to reduce 21st-birthday drinking: a randomized controlled trial of an event-specific prevention intervention. *Journal of Consulting and Clinical Psychology* 2009;77:51–63. [PubMed: 19170453]
- Paschal MJ, Bersamin M, Fearnow-Kenney M, Wyrick D, Currey D. Short-Term Evaluation of a Web-Based College Alcohol Misuse and Harm Prevention Course (College Alc). *Journal of Alcohol and Drug Education* 2006;50:49–65.

- Read JP, Kahler CW, Strong DR, Colder CR. Development and preliminary validation of the young adult alcohol consequences questionnaire. *Journal of Studies on Alcohol* 2006;67:169–177. [PubMed: 16536141]
- Saitz R, Palfai TP, Freedner N, Winter MR, Macdonald A, Lu J, et al. Screening and brief intervention online for college students: The ihealth study. *Alcohol and Alcoholism* 2007;42:28–36. [PubMed: 17130139]
- Tabachnick, BG.; Fidell, LS. *Using multivariate statistics* (3rd edition). New York: Harper Collins College Publishers; 1996.
- U.S. Department of Health and Human Services. *Healthy People 2010: Volume II*. Washington: DC: Government Printing Office; 2000. Washington: DC
- Wall A. Evaluating a health education web site: The case of AlcoholEdu. *NASPA Journal* 2007;44:692–714.
- Walters ST, Vader AM, Harris TR. A controlled trial of web-based feedback for heavy drinking college students. *Prevention Science*. 2007
- Walters ST, Wright JA, Shegog R. A review of computer and internet-based interventions for smoking behavior. *Addictive Behaviors* 2006;31:264–277. [PubMed: 15950392]
- Wechsler H, Dowdall GW, Davenport A, Rimm EB. A gender-specific measure of binge drinking among college students. *American Journal of Public Health* 1995;85:982–985. [PubMed: 7604925]
- Wechsler H, Isaac N. “Binge” drinkers in Massachusetts colleges: Prevalence, drinking style, time trends, and associated problems. *Journal of the American Medical Association* 1992;267:2929–2931. [PubMed: 1583763]
- Wechsler H, Lee JE, Kuo M, Seibring M, Nelson TF, Lee H. Trends in college binge drinking during a period of increased prevention efforts. Findings from 4 Harvard School of Public Health College Alcohol Study surveys: 1993–2001. *Journal of American College Health* 2002;50:203–217. [PubMed: 11990979]
- White HR. Reduction of alcohol-related harm on United States college campuses: The use of personal feedback interventions. *International Journal of Drug Policy* 2006;17:310–319.

Table 1
Raw alcohol use variables at baseline (before coming to campus) and follow up by condition

Measure	Assessment (n = 24)		e-Chug (n = 30)		AlcoholEdu (n = 26)		F (baseline)		F (follow up)		Effect Size at 1 month (w/in-group change)	
	M (SD)	M (SD)	M (SD)	M (SD)	M (SD)	M (SD)	F(2, 75)	F(2, 75)	F(2, 68)	F(2, 68)	Assessment =	e-Chug =
Typical drinks/drinking occasion, past month												
Baseline	2.81 (2.19)	3.43 (3.11)	3.04 (2.79)	3.04 (2.79)	3.04 (2.79)	3.04 (2.79)	F(2, 75) = 0.78	F(2, 75) = 0.78			Assessment = -.71	e-Chug = -.10
1-month	4.96 ^a (3.69)	3.74 ^b (3.40)	2.88 ^b (2.61)	2.88 ^b (2.61)	2.88 ^b (2.61)	2.88 ^b (2.61)			F(2, 68) = 6.76 ^{**}	F(2, 68) = 6.76 ^{**}	AlcoholEdu = .06	AlcoholEdu = .06
Peak drinks/drinking occasion, past month												
Baseline	4.63 (4.52)	4.87 (5.28)	4.35 (4.36)	4.35 (4.36)	4.35 (4.36)	4.35 (4.36)	F(2, 75) = 0.91	F(2, 75) = 0.91			Assessment = -.62	e-Chug = -.08
1-month	8.13 ^a (6.65)	5.27 ^b (4.94)	4.31 ^b (4.06)	4.31 ^b (4.06)	4.31 ^b (4.06)	4.31 ^b (4.06)			F(2, 68) = 10.21 ^{***}	F(2, 68) = 10.21 ^{***}	AlcoholEdu = .01	AlcoholEdu = .01
Ave. no. of drinks/week, past month												
Baseline	6.63 (8.86)	8.86 (10.21)	6.36 (8.30)	6.36 (8.30)	6.36 (8.30)	6.36 (8.30)	F(2, 75) = 0.40	F(2, 75) = 0.40			Assessment = -.59	e-Chug = .16
1-month	12.96 ^a (12.32)	7.43 ^b (7.92)	7.88 ^b (11.10)	7.88 ^b (11.10)	7.88 ^b (11.10)	7.88 ^b (11.10)			F(2, 68) = 12.52 ^{***}	F(2, 68) = 12.52 ^{***}	AlcoholEdu = -.16	AlcoholEdu = -.16
No. heavy drinking episodes, past month												
Baseline	1.25 (2.04)	1.40 (2.22)	1.38 (2.04)	1.38 (2.04)	1.38 (2.04)	1.38 (2.04)	F(2, 75) = 0.01	F(2, 75) = 0.01			Assessment = -.78	e-Chug = -.24
1-month	3.58 ^a (3.70)	2.00 ^b (2.79)	1.96 ^b (3.23)	1.96 ^b (3.23)	1.96 ^b (3.23)	1.96 ^b (3.23)			F(2, 68) = 8.25 ^{***}	F(2, 68) = 8.25 ^{***}	AlcoholEdu = -.21	AlcoholEdu = -.21
Typical estimated BAC, past month												
Baseline	.04 (.05)	.05 (.06)	.05 (.06)	.05 (.06)	.05 (.06)	.05 (.06)	F(2, 75) = 0.59	F(2, 75) = 0.59			Assessment = -.55	e-Chug = .33
1-month	.08 ^a (.09)	.05 ^b (.05)	.04 ^b (.05)	.04 ^b (.05)	.04 ^b (.05)	.04 ^b (.05)			F(2, 68) = 4.80 [*]	F(2, 68) = 4.80 [*]	AlcoholEdu = .18	AlcoholEdu = .18
Peak estimated BAC, past month												
Baseline	.07 (.08)	.08 (.10)	.08 (.10)	.08 (.10)	.08 (.10)	.08 (.10)	F(2, 75) = 0.11	F(2, 75) = 0.11			Assessment = -.67	e-Chug = .00
1-month	.15 ^a (.15)	.08 ^b (.08)	.08 ^b (.09)	.08 ^b (.09)	.08 ^b (.09)	.08 ^b (.09)			F(2, 68) = 9.99 ^{***}	F(2, 68) = 9.99 ^{***}	AlcoholEdu = .00	AlcoholEdu = .00
No. negative alcohol consequences, past month												
Baseline	4.04 (4.63)	4.60 (6.51)	4.54 (5.68)	4.54 (5.68)	4.54 (5.68)	4.54 (5.68)	F(2, 75) = 0.06	F(2, 75) = 0.06			Assessment = -.26	e-Chug = .08
1-month	5.46 ^a (6.28)	4.10 ^{a,b} (6.41)	2.85 ^b (5.02)	2.85 ^b (5.02)	2.85 ^b (5.02)	2.85 ^b (5.02)			F(2, 68) = 2.74 [†]	F(2, 68) = 2.74 [†]	AlcoholEdu = .32	AlcoholEdu = .32

*** Notes. $p \leq .001$.

** $p \leq .01$.

* $p \leq .05$

† $< .10$. BAC = Blood alcohol concentration. Alcohol consequences measured by the Young Adult Alcohol Consequence Questionnaire. Effect size calculated using Cohen's d . Different superscripts indicate conditions that differed significantly from other groups at $p < .05$.

Table 2

Between-groups effect sizes between assessment-only controls, e-Chug, and AlcoholEdu conditions

	Control Vs.		e-Chug Vs.
	e-Chug	AlcoholEdu	AlcoholEdu
Typical drinks/drinking occasion, past month	.61	.75	.07
Peak drinks/drinking occasion, past month	.60	.68	.03
Ave. no. of drinks/week, past month	.85	.68	-.11
No. heavy drinking episodes, past month	.54	.63	.13
Estimated typical BAC, past month	.60	.59	-.02
Peak estimated BAC, past month	.69	.69	.01
No. negative alcohol consequences, past month	.34	.56	.20

Note. Cohen's *d* was calculated using estimated means (adjusted for gender and baseline values of the dependent variable) with pooled standard deviations. A positive effect size indicated a mean decrease in behaviors for the comparison group (AlcoholEdu or e-Chug) relative to the reference group (Control or e-Chug), and a negative effect size indicated a mean increase in behaviors for the comparison group relative to the reference group.