SCREENING AND BRIEF INTERVENTION ONLINE FOR COLLEGE STUDENTS: THE iHEALTH STUDY

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Abstract — Aims: To test the feasibility of online alcohol screening and brief intervention (BI) by comparing (i) two approaches to inviting all students to be screened, and (ii) a minimal versus a more extensive BI. Methods: Freshmen students at one university were randomized to receive one of two types of email invitations to an online anonymous: (i) general health assessment, or (ii) alcohol-specific assessment. All were linked to the same alcohol screening survey. Those with unhealthy alcohol use (AUDIT >8) were randomly assigned to minimal or more extensive online alcohol BI. Results: In both invitation groups (4008 students), 55% of students completed the online screening. Overall, 37% of men and 26% of women had unhealthy alcohol use. Compared to minimal BI, more extensive BI was associated with intention to seek help among men and with a greater increase in readiness to change among women. One month after BI, 75% of students completed another assessment, 33% of women and 15% of men with unhealthy alcohol use at baseline no longer had unhealthy alcohol use. There were no significant differences on drinking measures by BI randomization group. Conclusions: Over half of an entire freshman class of college students were reached by email and completed alcohol screening and brief intervention. Even an alcohol-specific invitation did not deter students. Although brief interventions that differed had some gender specific effects on readiness to change and intention, in general, unhealthy alcohol use decreased after brief intervention. Web screening and brief intervention show promise for addressing unhealthy alcohol use by college students.

INTRODUCTION

Unhealthy alcohol use, ranging from risky drinking through abuse and dependence, is common among college students (Hingson et al., 2002; Wechsler et al., 2002). Almost half (44%) of college students report one or more heavy drinking episodes in a 2 week period, while 37% meet criteria for alcohol abuse or dependence (Knight et al., 2002). Freshmen students in particular are at higher risk for heavy drinking and alcohol-related consequences, such as poisoning, injuries, and assaults (Pope, et al., 1990; Turrisi et al., 2000; Gruenewald et al., 2003).

Alcohol screening tests to identify unhealthy use have been validated in college samples (Fleming et al., 1991; Clements, 1998; Aertgeerts et al., 2000; Kokotailo et al., 2004), and brief interventions can reduce drinking and its consequences (Marlatt et al., 1998; Baer et al., 2001; Larimer et al., 2002), but these strategies have generally not been tested using campus-wide approaches that reach large numbers of students. Fully 93% of American college students regularly use the Internet (Fleming et al., 2002), and ~25% of Internet users aged 15–24 years have looked up information about drug or alcohol problems (The Kaiser Family Foundation, 2001). Several websites that assess drinking and provide normative feedback or brief intervention have been developed (Cunningham et al., 2000; Koski-Janne and Cunningham, 2001; Cloud et al., 2001), and several sites have been designed for college students specifically (Walters, 2000; Walters et al., 2000; Schroeder, 2001; Chiauzzi et al., 2005; Moore et al., 2005; Walters et al., 2005b). These sites vary in their theoretical underpinnings (e.g. health education versus brief intervention principles), length of the program, time to complete the program, and cost. Most of these sites have not yet been evaluated to determine the relationship between these various features and efficacy.

Thus, although the web may be a reasonable medium for achieving universal screening and increasing participation in brief intervention by college students, the best approaches to implementation remain unknown. For example, some studies have taken the approach of embedding an alcohol screening test within a general health assessment (Fleming et al., 1997). Whether such an approach is necessary and more efficacious than an approach focused on alcohol screening and brief intervention remains unknown; these approaches have not yet been compared in randomized trials.

Therefore, this study aimed to compare two different recruitment strategies for universal screening and to pilot test two levels of online brief intervention for college students with unhealthy alcohol use. We expected to find that electronic mail recruitment and web-based brief intervention for those with unhealthy alcohol use would be a feasible strategy for reaching freshman college students. We hypothesized that (i) an email invitation to a general-health screening would produce a greater student response than an invitation to an alcohol-specific screening; and (ii) a more extensive online
brief intervention would be more effective than a minimal brief intervention.

METHODS

The Institutional Review and Privacy Boards of Boston University Medical Center approved this study with a waiver of consent elements and of documentation and HIPAA authorization.

Eligibility and enrollment

Eligible subjects were all freshman at a large urban private university in the Northeast who were ≥18 years and had a valid university email address.

All eligible students received an introductory email from the Dean of Students on October 1, 2004. This email encouraged students to participate, explaining that those who completed the assessment survey would be eligible for a drawing to win one of twenty $50 Amazon.com gift certificates. The email also assured students that the study was anonymous and voluntary, meaning that university officials would not know whether a student participated and would not have access to individual survey responses.

The actual invitation to participate in the study, as well as a hypertext link to access the assessment survey was sent on October 4, 2004 by the university Information Technology Department, from the iHealth@bu.edu email address. The deadline for completing the assessment was October 15. Up to two email reminders were sent to non-respondents.

In order to access the survey, students created a study identification code (ID) that contained no unique identifiers. To create the ID, students were prompted to enter (i) the first letter of their first name, (ii) the last letter of their last name, (iii) the last 2 digits of their university identification number, and (iv) the first and last letters of town/city where they last attended school.

Study design

There were two randomizations in this study. First, freshman class email addresses were randomized (simple randomization) to receive either a general health screening invitation or an alcohol-specific invitation to participate in the study. Both the invitation emails contained a link to the same web-based alcohol assessment.

Second, immediately following this assessment, all students received an online individualized ‘minimal’ brief intervention (BI). Students with unhealthy alcohol use—that is, those with an Alcohol Use Disorders Identification Test (AUDIT) score of ≥8—were subsequently randomized to receive either additional, ‘more extensive’ BI or no additional intervention. This second randomization was executed with stratification on AUDIT score (8–11 versus ≥12) and invitation group (general health versus alcohol-specific).

In all cases, the brief intervention was followed by further assessment and an invitation to receive a follow-up survey one month later. Students were told that those completing this later survey would be eligible for a drawing to win one of ten $100 Amazon.com gift certificates or a an Apple iPod™. Students were then provided with a list of web links for online resources related to all of the health behaviors asked about in the initial assessment.

One month later, students who enrolled for follow-up were sent email invitations to complete a final assessment, again described as either a general health or alcohol assessment, consistent with the initial invitation randomization. Students received the same prompts to facilitate re-entry of their ID. If the ID entered at follow-up did not match a baseline ID, the ID was still accepted and the subject was permitted to complete the assessment. Non-responders were sent up to two reminder emails. Follow-up surveys were completed before students left the university for Thanksgiving break.

Assessments

We incorporated validity checks into the web assessment survey and required that all items on a page be completed in order to continue. Demographics (gender, ethnicity, and race) and subjects’ past month health behaviors in the following areas were assessed: aerobic activity (Godin and Shepherd, 1985), sleep habits (Wolfson et al., 2003), smoking status, stress (Cohen et al., 1983), and alcohol use.

All subjects were screened for unhealthy alcohol use by means of the AUDIT (Reinert et al., 2002). The AUDIT is a brief instrument and has been validated in at least four studies in colleges (Fleming et al., 1991; Clements, 1998; Aertgeerts et al., 2000; Kokotailo et al., 2004); it is similarly accurate when done by computer or paper and pencil (Chan-Pensley, 1999) Several AUDIT response options were modified to allow more detailed responses with regard to consumption quantity and frequency. Three additional questions were included to determine past-month alcohol consumption (number of drinks per typical week, maximum number of drinks on one occasion, and number of heavy drinking episodes) (National Institute on Alcohol Abuse and Alcoholism, 2003). An AUDIT score of ≥8 was used as the cut-off for unhealthy alcohol use (Kokotailo et al., 2004). Subjects were then asked a single item regarding their readiness to change drinking [a 0–10 visual analogue scale included the following descriptions: 0 indicated ‘No thought of changing’; 2 indicated ‘Think I need to consider changing someday’; 5 indicated ‘Think I should change, but not quite ready’; 8 indicated ‘Starting to think about how to change my drinking patterns’; 10 indicated ‘Taking action to change (e.g. cutting down)’] (Miller et al., 2002).

Students with unhealthy alcohol use were asked 13 items from the Young Adult Alcohol Problem Screening Test (YAAPST) (Hurlbut et al., 1992). The items were those that (i) were not redundant with the AUDIT, and (ii) had <50% prevalence but were not rare, as indicated by surveys completed in 2002 and 2003 by 547 freshmen students in introductory psychology courses at the same university.

Following the brief intervention there was a single item assessing help-seeking intention, three drinking age of onset questions (Wechsler; National Institute on Alcohol Abuse and Alcoholism, 2002), and an item about family history (National Institute on Alcohol Abuse and Alcoholism, 2002).

Readiness to change drinking was re-assessed post-BI. A single item assessed subjects’ preference for obtaining personalized information about exercise, stress, and alcohol (e.g. web versus other). The follow-up assessment included reassessment of the domains covered at baseline, with the exception of characteristics that would not change (e.g. race).
Brief intervention (minimal versus more extensive)

The intervention was based on elements of BASICS (Dimeff et al., 1999), motivational interviewing (Miller et al., 2002), self-change approaches (Sobell and Sobell, 1993), and feedback about social norms (Baer et al., 1991; Agostinelli et al., 1995; Perkins et al., 1999). Normative comparisons were based on data from the previously mentioned introductory psychology students. Minimal BI consisted of three web screens. The first two showed gender-specific graphic comparison to local norms for (i) number of drinks per typical week in the past month, and (ii) number of heavy drinking episodes in the past month (defined as ≥5 drinks on an occasion for men, ≥4 for women). The third web screen provided information about drinking guidelines, dependence symptoms, pregnancy, legal drinking age, coexisting medical conditions, and medication use.

Students in the more extensive BI group received three additional web screens: (i) highest blood alcohol level obtained in the past month and a chart describing the effects of alcohol on cognition and behavior at different levels, (ii) a graphic profile of consequences of drinking reported in the past year, with normative information about the percent of freshmen of the same gender experiencing these consequences (see Fig. 1), and (iii) the amount of money spent per week and per year on alcohol, the number of alcohol calories consumed per month (also reported as the equivalent number of sticks of butter), and the amount of time required on a treadmill to burn these calories and maintain current weight. After the feedback screens, all students were shown specific drinking guidelines and risk levels, a description of alcohol dependence symptoms, referral information, and a page of alcohol assistance web links. All students received feedback regarding sleep, stress, physical activity, and (for smokers) smoking.

Outcomes

The primary outcome measure was the proportion of students completing the entire initial assessment. Outcomes immediately post-intervention included readiness to change and intention to seek help (for those with unhealthy alcohol use). Additional outcomes included the proportions of students who both enrolled for and completed the 1-month follow-up; the prevalence of unhealthy alcohol use at follow-up; and changes in drinking outcomes from initial assessment to follow-up (drinks per week, heavy drinking episodes, and maximum number of drinks on a single occasion).

Statistical analysis

All analyses were carried out using SAS/STAT software version 8.2.(1999) Initial analyses consisted of descriptive statistics (means, standard deviations, medians, interquartile ranges, and proportions). Comparisons were performed with two-sample t-tests for continuous variables and chi square tests for categorical variables. Reported p-values are two-tailed, with a P-value <0.05 considered statistically significant. Among students with identical IDs, changes from initial assessment to follow-up (drinks per week, heavy drinking episodes, and maximum number of drinks on a single occasion).

Sample size and statistical power

The pilot trial was designed to have 90% power, using a two-tailed alpha of 0.05, to detect a difference in response rates of 50 versus 55% between the two invitation approaches. For alcohol consumption measurement outcomes, the trial was designed to have 80% power to detect an effect size of 0.30 using a two-sample t-test with a two-tailed alpha at the 0.05 level. For the categorical outcome intention to seek help, there was 80% power for detecting an increase from 10 to 22%.

RESULTS

Subject characteristics and completion by invitation type

Invitation emails were sent to 4008 freshman students (2004 in each of the two invitation conditions; Fig. 2). There were only six unsuccessful transmissions in each of the two invitation groups. Overall, 2,194 (54.7%) students completed the initial assessment; this included 13 assessments completed by university students who had not been invited (12 followed the general-health invitation link and one followed the alcohol-specific link [they could not be removed from the analytic sample because there was no link maintained between the data and any identifiers]). There were no statistically significant differences in baseline drinking characteristics, other health behaviors, or stress by invitation group (Table 1). There was no difference in completion rate by invitation group: 54.8% in the alcohol-specific invitation group versus 54.6% in the general health invitation group. A total of 95% of
students who logged on to the assessment website completed the entire initial assessment.

Gender and race/ethnicity were similar to that of the freshman class, which was 40% male, 12% Asian, 62% White, and 9% Other/Hispanic (Table 1). One quarter of respondents were abstinent (males 27% and females 25%), and half had at least one heavy drinking episode in the past 30 days (males 53% and females 51%). Many (41%) stated they would use the web and 6% the phone to obtain personalized information about drinking.

Unhealthy alcohol use: subject characteristics, randomization, and immediate outcomes

About one-third of respondents (n = 650) reported unhealthy alcohol use (AUDIT ≥8) (males 37% and females 26%). Of those with unhealthy alcohol use, 41% stated that they would use the web and 6% the telephone to obtain personalized information regarding drinking. Among the 650 subjects with unhealthy alcohol use, there were no differences in demographics or drinking characteristics between the two brief intervention groups (Table 2). Subjects with unhealthy alcohol use reported earlier initiation of drinking. By age 14, those with unhealthy alcohol use were more likely than those without, to have had a first drink (20.0 versus 11.2%, \( P < 0.0001 \)), to have had a drink at least once a week (1.9 versus 0.53%, \( P < 0.007 \)), and to have gotten drunk (9.7 versus 3.0%, \( P < 0.0001 \)). Unhealthy drinkers were also significantly more likely to report a family history of alcohol problems (42.5 versus 31.8%, \( P < 0.0001 \)).

Immediately post-intervention during the initial assessment, 8.9% of subjects with unhealthy alcohol use indicated that they intended to seek assistance in cutting down or stopping drinking. Among men, those in the more extensive BI group were significantly more likely than those in the minimal BI group to report intentions to seek help (13 versus 5%, \( P = 0.016 \))(Table 3).

![Fig. 2. Participant flow through study.](https://academic.oup.com/alcalc/article-abstract/42/1/28/163220)

**Table 1. Characteristics of 2194 college freshmen completing online health assessment, by gender and invitation randomization group**

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Male (n = 797)</th>
<th>Female (n = 1397)</th>
<th>General-health invitation (n = 1099)</th>
<th>Alcohol-specific invitation* (n = 1095)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female (%)</td>
<td>—</td>
<td>100</td>
<td>62</td>
<td>65</td>
</tr>
<tr>
<td>Hispanic (%)</td>
<td>6</td>
<td>7</td>
<td>15</td>
<td>10</td>
</tr>
<tr>
<td>Race (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>71</td>
<td>76</td>
<td>74</td>
<td>73</td>
</tr>
<tr>
<td>Asian</td>
<td>20</td>
<td>14</td>
<td>15</td>
<td>17</td>
</tr>
<tr>
<td>Other</td>
<td>9</td>
<td>11</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Exercise (days/week) (Mean, SD)</td>
<td>2.5 (2.0)</td>
<td>2.2 (1.9)</td>
<td>2.2 (1.9)</td>
<td>2.3 (2.0)</td>
</tr>
<tr>
<td>Exercise (minutes/day) (Mean, SD)</td>
<td>41.9 (40.4)</td>
<td>34.7 (33.9)</td>
<td>36.6 (36.0)</td>
<td>38.0 (37.2)</td>
</tr>
<tr>
<td>Sleep (hours/night) (Mean, SD)</td>
<td>6.6 (1.2)</td>
<td>6.5 (1.2)</td>
<td>6.5 (1.2)</td>
<td>6.5 (1.2)</td>
</tr>
<tr>
<td>Stress** (past 30 days) (%)</td>
<td>33</td>
<td>45</td>
<td>42</td>
<td>40</td>
</tr>
<tr>
<td>Current smoker*** (%)</td>
<td>9</td>
<td>10</td>
<td>9</td>
<td>10</td>
</tr>
<tr>
<td>Alcohol use characteristics:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AUDIT ≥8 (%)</td>
<td>37</td>
<td>26</td>
<td>29</td>
<td>30</td>
</tr>
<tr>
<td>Abstinent (%)</td>
<td>27</td>
<td>25</td>
<td>26</td>
<td>27</td>
</tr>
<tr>
<td>Heavy drinking episodes* (past 30 days) (%)</td>
<td>53</td>
<td>51</td>
<td>52</td>
<td>52</td>
</tr>
</tbody>
</table>

*There were no statistically significant differences by invitation randomization group.

**Positive response to either of the following questions: In the past 30 days, have you (i) felt that you were unable to control the important things in your life, or (ii) felt difficulties were piling up so high that you could not overcome them?**

***Positive response to the question: Do you currently smoke cigarettes?**
Table 2. Characteristics of 650 drinkers with unhealthy alcohol use by gender and intervention randomization group

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Gender</th>
<th>Intervention randomization group*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Male (n = 292)</td>
<td>Female (n = 358)</td>
</tr>
<tr>
<td>Female (%)</td>
<td>—</td>
<td>100</td>
</tr>
<tr>
<td>Hispanic (%)</td>
<td>6</td>
<td>5</td>
</tr>
<tr>
<td>Race (%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>79</td>
<td>83</td>
</tr>
<tr>
<td>Asian</td>
<td>12</td>
<td>10</td>
</tr>
<tr>
<td>Other</td>
<td>9</td>
<td>7</td>
</tr>
<tr>
<td>AUDIT 12 or more</td>
<td>46</td>
<td>40</td>
</tr>
<tr>
<td>No. of drinks/week (past 30 days)</td>
<td>22.2 (22.4)</td>
<td>12.4 (8.4)</td>
</tr>
<tr>
<td>No. of most drinks per occasion (past 30 days)</td>
<td>12.6 (7.2)</td>
<td>8.4 (3.9)</td>
</tr>
<tr>
<td>No. of heavy drinking episodes (past 30 days)</td>
<td>6.2 (3.9)</td>
<td>5.9 (3.8)</td>
</tr>
<tr>
<td>No. of alcohol consequences (past year)</td>
<td>3.1 (2.2)</td>
<td>3.4 (2.1)</td>
</tr>
<tr>
<td>Readiness to change drinking**</td>
<td>2.0 (2.4)</td>
<td>2.1 (2.6)</td>
</tr>
<tr>
<td>Family history of alcoholism*** (%)</td>
<td>38</td>
<td>46</td>
</tr>
<tr>
<td>Age had first drink of alcohol** [mean (SD)]</td>
<td>14.6 (2.3)</td>
<td>14.8 (2.0)</td>
</tr>
<tr>
<td>Age first drank 1 time per week** [mean (SD)]</td>
<td>16.0 (4.0)</td>
<td>15.2 (5.0)</td>
</tr>
<tr>
<td>Age first drank [mean (SD)]</td>
<td>15.3 (2.3)</td>
<td>15.4 (1.9)</td>
</tr>
</tbody>
</table>

*Represents the sum of the number of consequences endorsed by the subject.

**Response to the question: About how old were you when you first had your first drink of alcohol, other than a few sips?*

***Response to the question: About how old were you when you first started drinking at least once a week?***

There were no statistically significant differences by intervention randomization group.

**Response to the instruction: Each rung on this ladder represents where various people are in their thinking about changing their drinking. Fill in the number (on a scale from 0 to 10 with 0 indicating no thought of changing and 10 indicating taking action to change) that best indicates where you are now.**

***Positive response to the question: In your judgment, have any of the following people (mother/father/brothers/sisters, grandparents/aunts/uncles) been alcoholics or problem drinkers at any time in their lives?***

Table 3. Help-seeking and changes in readiness assessed immediately after completion of initial assessment and intervention for 650 subjects with unhealthy alcohol use*

<table>
<thead>
<tr>
<th></th>
<th>Minimal intervention (n = 326)</th>
<th>More extensive intervention (n = 324)</th>
<th>P-value for intervention group comparison</th>
</tr>
</thead>
<tbody>
<tr>
<td>Change in readiness to change drinking ** [Mean,SD]</td>
<td>0.2 (1.2)</td>
<td>0.5 (1.5)</td>
<td><strong>0.01</strong></td>
</tr>
<tr>
<td>Male</td>
<td>0.1 (1.0)</td>
<td>0.3 (1.1)</td>
<td>0.21</td>
</tr>
<tr>
<td>Female</td>
<td>0.3 (1.3)</td>
<td>0.7 (1.6)</td>
<td><strong>0.03</strong></td>
</tr>
<tr>
<td>Intention to seek help*** (%)</td>
<td>8</td>
<td>10</td>
<td>0.26</td>
</tr>
<tr>
<td>Male</td>
<td>5</td>
<td>13</td>
<td><strong>0.02</strong></td>
</tr>
<tr>
<td>Female</td>
<td>10</td>
<td>8</td>
<td>0.54</td>
</tr>
</tbody>
</table>

*Unhealthy alcohol use includes the spectrum from risky drinking amounts through alcohol dependence, and is defined here as an AUDIT score ≥8

**Response to the instruction: Each rung on this ladder represents where various people are in their thinking about changing their drinking. Fill in the number on a scale from 0 to 10 with 0 indicating no thought of changing and 10 indicating taking action to change) that best indicates where you are now.***

***Positive response to the question: Do you intend to seek any assistance in cutting down or stopping drinking?***

Results in bold type indicate statistical significance.

to those in the minimal BI group, subjects with unhealthy alcohol use in the more extensive BI group had a significantly greater increase in readiness to change drinking (mean score change +0.5 (SD 1.5) versus +0.2 (SD 1.2), P = 0.01), an effect that was statistically significant for women but not men.

Follow-up: all subjects

Of the 2194 students who completed the initial assessment, 1874 (85.4%) agreed to complete the follow-up assessment. There were no differences in agreement to follow-up by gender (males 85.2% and females 85.5%) or by invitation randomization group (alcohol group 85.1%, general health group 85.7%). However, subjects with unhealthy alcohol use were less likely than other students to agree to follow-up (82.0 versus 86.9%, P = 0.003). Among students with unhealthy alcohol use at initial assessment, there was no difference between the two brief intervention groups in agreement to follow-up (minimal BI 81.6%, more extensive BI 82.4%).

Of the 1874 subjects who agreed to complete follow-up, 12 completed the initial assessment after the deadline and therefore were not eligible to complete the follow-up. Of the subjects who agreed and were eligible to complete follow-up, 74.6% (1389 out of 1862) completed the follow-up assessment (Fig. 2). At follow-up, 26.2% of subjects had unhealthy alcohol use (compared with 29.6% at baseline). Among men, a similar proportion had unhealthy alcohol use at baseline (36.6%) and follow-up (37.3%), but a smaller proportion of women at follow-up (20.3%) than at baseline (25.6%) had unhealthy alcohol use.

Follow-up and 1-month outcomes: subjects with unhealthy alcohol use

At follow-up, 47.4% of subjects (883/1862) provided a study ID identical to that at initial assessment, allowing data to be linked. There was no difference in the proportion of linked subjects between those with and without unhealthy alcohol use (44.5 and 48.6%, respectively, P = 0.113). An additional 19.1% (355 out of 1862) had study IDs at initial assessment and follow-up that did not differ by more than one character.
(and were of the same gender). There was no difference in proportion of IDs that were off by one character between subjects with and without unhealthy alcohol use (16.9 and 19.9%, respectively, \( P = 0.127 \)).

We examined changes over time in the 235 subjects with unhealthy alcohol who had linked initial and follow-up assessments (Table 4). There were no statistically significant differences on drinking measures by brief intervention randomization group. Overall, unhealthy alcohol use decreased among men by 15% [95% confidence interval (CI) 8–21] and among women by 33% [95% CI, 25–41]. Compared to the initial assessment, female students drank less per week (mean change –1.7 drinks (SD 6.8), \( P = 0.005 \)) and had fewer heavy drinking episodes (mean change –0.8 episodes (SD 3.0), \( P = 0.003 \)) and that differed by one character from initial assessment. Among women, a decrease in maximum drinks per occasion became significant (mean change –0.5 drinks (SD 3.3), \( P = 0.098 \)) was not significant. Among males, there were no changes in consumption.

We repeated the analyses of brief intervention outcomes including subjects who had study IDs that were identical to and that differed by one character from initial assessment. Again, there were no statistically significant differences on drinking measures by BI randomization group. Changes from initial assessment to follow-up were similar to those seen in primary analyses except that for women the decrease in maximum drinks per occasion became significant (mean change –0.72 drinks (SD 3.14), \( P = 0.0026 \)).

### DISCUSSION

In this study, a brief, web-based alcohol assessment and brief intervention reached a large proportion of students (more than half) despite participation not being required by school administrators, despite not providing compensation to all respondents, and despite a lack of any personal contact. One-third of these students had unhealthy alcohol use. We employed two approaches to inviting students to participate (general-health versus alcohol-specific email invitations). Despite concerns that students might be deterred from completing an ‘alcohol’ assessment, response rates for subjects were comparable in both groups. Similar proportions of students completed the intervention regardless of whether they had to complete a minimal or more extensive intervention. The more extensive brief intervention may have had greater efficacy increasing readiness to change drinking (particularly in women) and intention to seek help (in men), than minimal brief intervention. These two gender-specific results should be considered hypothesis generating. And most participating students completed a one-month follow-up assessment during which fewer students (more so for women) reported unhealthy alcohol use, regardless of brief intervention (BI) group, which should also be considered a preliminary finding.

Our overall findings resemble benefits identified by others of electronic (web, personal computer) brief interventions in colleges and other settings (Hester et al., 1997; Dimeff et al., 2000; Miller, 2001; Neighbors et al., 2004; Chiauzzi et al., 2005). Computers have been used to assist physicians with providing interventions to patients (Hester et al., 1997; Dimeff et al., 2000). Personal computer-based BIs delivered by inviting college students to present to a location on campus also have promise. Six-weeks after a BI, subjects decreased number of drinks and heavy drinking episodes (Kypri et al., 2004). Though these decreases in consumption no longer reached significance at 6-months, reductions in alcohol consequences remained significant. In another study, a computerized BI resulted in reductions in consumption at 3 and 6 months (Neighbors et al., 2004). In a third study, when compared to a no-treatment group, a computer-based BI yielded alcohol consumption and consequence decreases similar to that of an in-person Alcohol Skills Training Program (ASTP) (Miller, 2001).

There are few studies of the use of the web to deliver BI to students wherever they may be. In one such study, Chiauzzi et al. (2005) found that although web-BI did not appear to have an overall effect, it was beneficial for certain

<table>
<thead>
<tr>
<th>Overall ((n = 235))</th>
<th>Statistics for time effects</th>
<th>Minimal intervention ((n = 109))</th>
<th>More extensive intervention ((n = 126))</th>
<th>(P)-value for intervention group differences</th>
</tr>
</thead>
<tbody>
<tr>
<td>AUDIT (\geq8) (absolute % change)</td>
<td>95% CI</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Men</td>
<td>–15</td>
<td>8–21</td>
<td>–17</td>
<td>–13</td>
</tr>
<tr>
<td>Women</td>
<td>–33</td>
<td>25–41</td>
<td>–33</td>
<td>–32</td>
</tr>
<tr>
<td>No. of drinks/week [mean (SD)]</td>
<td>(P)-value</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Men</td>
<td>–1.22 (25.03)</td>
<td>0.621</td>
<td>+0.12 (8.33)</td>
<td>–2.15 (31.78)</td>
</tr>
<tr>
<td>Women</td>
<td>–1.68 (6.75)</td>
<td>(0.005)</td>
<td>–2.37 (6.10)</td>
<td>–0.97 (7.34)</td>
</tr>
<tr>
<td>No. of heavy drinking episodes [mean (SD)]</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Men</td>
<td>–0.43 (5.37)</td>
<td>0.421</td>
<td>–0.52 (4.51)</td>
<td>–0.36 (5.92)</td>
</tr>
<tr>
<td>Women</td>
<td>–0.48 (3.30)</td>
<td>0.099</td>
<td>–0.67 (3.53)</td>
<td>–0.28 (3.06)</td>
</tr>
<tr>
<td>Overall readiness to change drinking ** [mean (SD)]</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Men</td>
<td>+0.32 (2.42)</td>
<td>0.182</td>
<td>+0.02 (2.01)</td>
<td>+0.52 (2.67)</td>
</tr>
<tr>
<td>Women</td>
<td>+0.17 (2.53)</td>
<td>0.450</td>
<td>–0.07 (2.72)</td>
<td>+0.42 (2.30)</td>
</tr>
</tbody>
</table>

**Table is limited to the 235 subjects with identical study IDs at initial and follow-up assessments. All outcomes are expressed as changes from initial assessment to follow-up.

**Response to the instruction: Each rung on this ladder represents where various people are in their thinking about changing their drinking. Fill in the number (on a scale from 0 to 10 with 0 indicating no thought of changing and 10 indicating taking action to change) that best indicates where you are now.’

Results in bold type indicate statistical significance.
student subgroups and outcomes. For example, persistent heavy drinkers (as compared with less persistent heavy drinkers) experienced a more rapid decrease in average and peak consumption as well as in a composite score. Women in the intervention group reported a significantly greater reduction in alcohol-related problems. Precontemplation-stage drinkers in the intervention group reduced average consumption at a faster rate than those in the control group. At least one screening and BI website appears to have efficacy in several small controlled trials, with decreased alcohol consumption and alcohol-related problems in college freshmen (Henry et al., 2004; Steiner et al., 2005; Walters et al., 2005a). We are unable to compare the magnitude of change we observed with that of these studies, since effect sizes for those other studies have not yet been reported.

Our response rate of 54% is equivalent to that reported in Marlatt et al.'s study, which recruited college subjects via mailed questionnaire (1998). Although today's postal mail studies are unlikely to duplicate such a rate, web-based research holds promise for maintaining or exceeding these rates. Our follow-up rate, at 74.6%, was similar to rates in other college web-based studies (72% at 4 weeks (Walters et al., 2005a), 80% at 6 weeks (Kypri et al., 2004), and 80% at 3 months (Chiauzzi et al., 2005)). Students with unhealthy alcohol use were less likely to be followed, but only by a small margin.

Although the optimal length and components of in-person BI are not known, very brief, single contacts are less efficacious than in-person, multi-contact BI’s. (U.S. Preventive Services Task Force, 2004) Also, most efficacious BI’s have some or all of the following components: personalized normative feedback, advice, and goal-setting. (U.S. Preventive Services Task Force, 2004) Adapting known efficacious in-person BI’s to the web does not guarantee their continued effectiveness or brevity. The web-BI’s with apparent efficacy consist of relatively brief, 10-min assessments, (Chiauzzi et al., 2005) with common components including personalized normative feedback and advice (Walters et al., 2005a). In this pilot study, we compared among three web brief intervention screens (minimal BI) and six web-BI screens (more-extensive BI); the additional screens provided feedback on highest blood alcohol level, consequences, costs and calories. In general, minimal and more extensive intervention were similarly effective. Whether this is because both forms of the intervention were relatively minimal, because the assessment (also minimal) had effects on drinking or whether intervention length is simply not important, cannot be determined from our data. Clearly an even more extensive intervention including specific advice and change strategies might have been more effective though extending the length might also limit public health impact (by limiting the number of students who participate). We also cannot determine whether specific components are essential. Therefore, further work is needed to identify optimal components and length (Del Boca et al., 2004).

Several limitations should be considered when interpreting the results of this study. First, there were invitation emails that were not successfully sent, and responses from students who had not been invited to participate. However, there were very few students in these groups. Second, we did not administer extensive alcohol assessments and therefore cannot characterize alcohol diagnoses or consumption details. In general, short, validated instruments were employed to maximize student participation. The readiness measure (examined as one of the outcomes), has not been well validated though it does seem to have face validity. Third, conclusions drawn from the follow-up assessment are limited by the study design. The design maintained anonymity in order to encourage enrollment, but this made measuring changes over time possible only for the sub-group of subjects who generated identical study IDs at initial assessment and follow-up. However, when we included subjects in analyses with IDs that did not differ by more than one character, results were similar. Nonetheless, the validity of analyses of drinking changes at follow-up may be threatened by this inability to link over half of the individual responses. However, our choice to implement an anonymous study was purposeful in that we wished to maximize the possibility that a student would complete the screening and assessment, thus replicating the way colleges would most likely use alcohol screening and BI if they intended maximum participation. If students had not had their data recorded anonymously and/or if they had to complete written informed consent or be presented with extensive confidentiality disclaimers (as required by the interpretation of human subjects regulations by some for such studies when done confidentially rather than anonymously) the level of participation would likely have been dramatically lower. We do recognize however, that web interventions could also be used by colleges for identifying students in need of assistance. A fourth potential limitation is that although the reductions in drinking in the linked sample are consistent with an effect of brief intervention, we cannot draw conclusions about the true efficacy of this approach without a no-intervention comparison group. And little should be made of the decrease in unhealthy use in the follow-up sample since these do not represent linked subjects. We did ensure that the period from initial assessment to follow-up did not include any breaks, major holidays, or final exams, when drinking patterns tend to show the greatest fluctuation (Del Boca et al., 2004). However, this design cannot substitute for an untreated control group. And the 1-month follow-up was short and we did not assess actual help-seeking over time, only intention to seek help; future studies should address long-term effects. Finally, the difference between the minimal and more extensive BI conditions was 3 web screens. This difference may not have been large enough to produce differences by BI group, potentially underestimating the effect of a more extensive BI. Furthermore, we cannot attribute differences in results to the difference in BI content versus length.

Despite these limitations, we were able to reach a large proportion of freshman students who completed alcohol screening, brief intervention, and one-month follow-up, and the study design also allowed comparison of two levels of intensity of brief intervention. Results also suggest that more extensive BI may have more efficacy for improving intention to seek help and readiness to change, but that even minimal BI may have decreased unhealthy alcohol use (though a secular trend cannot be excluded).

A number of questions remain regarding web-based screening and intervention for unhealthy alcohol use among college students. These include questions about widespread effectiveness (particularly for impact on alcohol consequences), necessary and sufficient components of web-based brief
interventions, duration, frequency and intensity of interventions, effects in important subgroups (e.g. gender), and comparisons of costs and effectiveness with other approaches. Nonetheless, universal alcohol screening and brief intervention online is feasible, the approach can reach many college students regardless of whether the message focuses on alcohol or general health, the feedback intervention can vary in length, and it may decrease unhealthy alcohol use. Web pages such as those used for this study could be available free of charge without restriction and could be implemented at colleges very inexpensively. With further study, the method could show promise for decreasing costs and consequences associated with drinking in a group of people with a high prevalence of heavy drinking and related consequences.

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