Randomized Controlled Trial of Proactive Web-Based Alcohol Screening and Brief Intervention for University Students

Kypros Kypri, PhD; Jonathan Hallett, BA; Peter Howat, PhD; Alexandra McManus, PhD; Bruce Maycock, PhD; Steven Bowe, MMedStat; Nicholas J. Horton, ScD

Background: University students drink more heavily than their nonstudent peers and are often unaware that their drinking is risky and exceeds normative levels. We tested the efficacy of a proactive Web-based alcohol screening and brief intervention program.

Methods: A randomized controlled trial was conducted at an Australian university in 2007. Invitations were sent to 13,000 undergraduates (age range, 17-24 years) to complete a Web-based Alcohol Use Disorders Identification Test. Of 7237 students who responded, 2435 scored in the hazardous/harmful range (≥8) and were randomized, and 2050 (84%) completed at least 1 follow-up assessment. Intervention was 10 minutes of Web-based motivational assessment and personalized feedback. Controls received only screening. Follow-up assessments were conducted at 1 and 6 months with observers and participants blinded to allocation. Outcome measures were drinking frequency, typical occasion quantity, overall volume, number of personal problems, an academic problems score, prevalence of binge drinking, and prevalence of heavy drinking.

Results: Mean (SD) baseline Alcohol Use Disorders Identification Test scores for control and intervention groups were 14.3 (5.1) and 14.2 (5.1), respectively. After 1 month, participants receiving intervention drank less often (rate ratio [RR], 0.89; 95% confidence interval [CI], 0.83-0.94), smaller quantities per occasion (RR, 0.93; 95% CI, 0.88-0.98), and less alcohol overall (RR, 0.83; 95% CI, 0.78-0.90) than did controls. Differences in alcohol-related harms were nonsignificant. At 6 months, intervention effects persisted for drinking frequency (RR, 0.91; 95% CI, 0.85-0.97) and overall volume (RR, 0.89; 95% CI, 0.82-0.96) but not for other variables.

Conclusion: Proactive Web-based screening and intervention reduces drinking in undergraduates, and such a program could be implemented widely.

Trial Registration: anzctr.org.au Identifier: ACTRN12608000104358

Arch Intern Med. 2009;169(16):1508-1514
services used by university students. In these studies, involving 3 to 5 minutes of Web-based screening and 10 minutes of Web-based personalized feedback, delivered in the health service waiting room, reductions were observed in unhealthy alcohol use of 20% to 30% lasting 6 to 12 months.16,17 There was also evidence that Web-based assessment alone produced reductions in drinking and personal, sexual, and legal problems lasting 12 months.18

A limitation of this approach is that many students do not regularly use university medical services. In a recent US study, a similar e-SBI program was implemented proactively by inviting first-year students to complete an online assessment of their drinking. Fifty-five percent of students completed online screening and were randomized to minimal or more extensive brief intervention.19 There were reductions in hazardous drinking in both groups after 1 month but no substantial difference between treatment groups. The study illustrates that a large proportion of the student population is willing to complete online screening. Given the nondifferential reduction in unhealthy alcohol use by treatment group, a strong inference about e-SBI’s effectiveness in this setting cannot be drawn. Previous evidence of assessment effects18 suggests that exposure to minimal brief intervention19 may have blurred the experimental contrast.

Considering the potential reach of a proactive e-SBI approach, there is value in contrasting this intervention with screening alone and in assessing outcomes beyond 1 month. Our aim was to determine the efficacy of a Web-based motivational intervention delivered after screening of a large population of undergraduates, with screening alone as the control.

METHODS

The study was a 2-arm, parallel, randomized controlled trial (Figure). We assumed a 50% prevalence of unhealthy alcohol use (Alcohol Use Disorders Identification Test [AUDIT] score ≥8) based on New Zealand research,20 there being no comparable estimates for Australia. We produced estimates for a 10% relative reduction (ie, from 50% to 45%) and a 15% relative reduction (ie, from 50% to 42.5%) in the prevalence of unhealthy alcohol use. Assuming a power of 0.80 with α=0.05, 1604 individuals per group were required to detect a 10% effect and 719 individuals per group to detect a 15% effect. With allowance for 34% attrition at 6 months, between 1089 and 2430 individuals per group were required to detect a 10% to 15% relative risk reduction.

RECRUITMENT

In cooperation with the university administration, we drew a random sample of 13 000 full-time undergraduates aged 17 to 24 years in March 2007 using survey recruitment procedures described in detail elsewhere.21,22 In summary, 4 weeks after the start of the first semester, all students were sent a letter by mail, followed by an e-mail containing a hyperlink to a Web questionnaire. Students were informed that the study concerned “the experiences of tertiary students with alcohol, and their views about certain aspects of drinking.” Up to 3 reminder e-mails were sent in the following weeks. Students were offered the opportunity to win 1 of 40 A$100 gift vouchers for participating.

WEB SITE

Respondents visited a Web site called THRIVE (Tertiary Health Research Intervention Via Email), consisting of a branched 7-page online questionnaire with items covering (1) demographics (sex, age, and living arrangement); (2) drinking in the last 12 months (yes/no); (3) AUDIT (10 questions)23; (4) largest number of standard drinks (10 g of ethanol) consumed on 1 occasion in the last 4 weeks, duration of the drinking episode in hours, and height and weight; (5) secondhand effects (eg, “being pushed, hit, or otherwise assaulted”), with the response options yes, no, or prefer not to answer24; (6) opinions on alcohol beverage labeling25; and (7) smoking history.

The survey instrument and feedback can be accessed at http://lamp.health.curtin.edu.au/thrive/baselinetest.php. A process evaluation study showed that university students found THRIVE easy to complete and personally relevant, and most of them said that they would recommend it to a friend.26
The intervention consisted of (1) an AUDIT score with an explanation of the associated health risk and information about how to reduce that risk; (2) an estimated blood alcohol concentration for the respondent’s heaviest episode in the previous 4 weeks, with information on the behavioral and physiological sequelae of various blood alcohol concentrations and traffic crash relative risk; (3) estimates of monetary expenditure per month and year; (4) bar graphs comparing episodic and weekly consumption with that of other students of the same age and sex; and (5) hyperlinks for smoking cessation and help with drinking problems. Three more Web pages were presented as options, offering facts about alcohol and tips for reducing the risk of alcohol-related harm as well as providing information about where to find medical help and counseling support. On completion of the 1-month assessment, intervention group participants received additional feedback, comparing drinking levels that they reported at 1 month with those at baseline, a form of booster intervention.26

Participants were blind to the true nature of the study, which was presented as a series of surveys, in accordance with ethical approval, provided by the research ethics committee of Curtin University, Perth, Australia. Researchers were blind to participants’ group allocation.

OUTCOMES AND FOLLOW-UP

One month after the initial assessment, all participants were sent a letter and then an e-mail containing a hyperlink to a Web-based follow-up questionnaire. Included with the letter was a $6 sandwich voucher that could be redeemed irrespective of whether they would recommend the site to a friend.

There were 3 planned primary outcome measures: frequency of drinking (range, 0-28 days); number of standard drinks per typical occasion, and average weekly volume [(28-day frequency X typical quantity)/4]. Secondary outcomes included the APS score (range, 0-14), the AREAS score (range, 0-15), prevalence of binge drinking (for women and men, respectively, >4 and >6 standard drinks on 1 occasion in the preceding 4 weeks), and prevalence of heavy drinking (for men and women, respectively, >14 and >28 standard drinks per week in the preceding 4 weeks). We also examined subjective treatment effects (decrease in drinking vs increase/no change) and whether participants sought help for their drinking (no/yes).

Table 1. Demographic Characteristics and Alcohol Use of the Study Groups at Baseline

<table>
<thead>
<tr>
<th></th>
<th>Control (n=1184)</th>
<th>Intervention (n=1251)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Women, %</td>
<td>45.5</td>
<td>45.1</td>
</tr>
<tr>
<td>Age, mean (SD), y</td>
<td>19.7 (1.8)</td>
<td>19.7 (1.8)</td>
</tr>
<tr>
<td>Living arrangement, %</td>
<td></td>
<td></td>
</tr>
<tr>
<td>With a parent or guardian</td>
<td>64.3</td>
<td>66.4</td>
</tr>
<tr>
<td>Shared house/student housing</td>
<td>29.7</td>
<td>27.2</td>
</tr>
<tr>
<td>Other</td>
<td>5.9</td>
<td>6.3</td>
</tr>
<tr>
<td>AUDIT score, mean (SD)</td>
<td>14.3 (5.1)</td>
<td>14.2 (5.1)</td>
</tr>
<tr>
<td>Drinking summary dataa</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Drinks alcohol 2 or more times per week, %</td>
<td>62.2</td>
<td>59.3</td>
</tr>
<tr>
<td>No. of standard drinks per typical drinking occasion, mean (SD)</td>
<td>8.5 (4.6)</td>
<td>8.5 (5.2)</td>
</tr>
<tr>
<td>Alcohol dependence subscale score, mean (SD)b</td>
<td>1.8 (1.8)</td>
<td>1.8 (1.8)</td>
</tr>
</tbody>
</table>

Abbreviation: AUDIT, Alcohol Use Disorders Identification Test.

a AUDIT items 1 and 2.
bSum of scores for AUDIT items 4 through 6.

Table 2. Unavailable for Follow-up Analysis

<table>
<thead>
<tr>
<th></th>
<th>Missing at 1 mo</th>
<th>Missing at 6 mo</th>
<th>Missing at Both Time Points</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Control Group</td>
<td>Intervention Group</td>
<td>Control Group</td>
</tr>
<tr>
<td>Women, No. (%)</td>
<td>(n=242)</td>
<td>(n=289)</td>
<td>(n=417)</td>
</tr>
<tr>
<td>Age, mean (SD), y</td>
<td>20.0 (1.9)</td>
<td>20.0 (1.9)</td>
<td>20.0 (1.9)</td>
</tr>
<tr>
<td>AUDIT score at baseline, mean (SD)</td>
<td>14.4 (5.2)</td>
<td>14.2 (5.0)</td>
<td>14.7 (5.2)</td>
</tr>
</tbody>
</table>

Abbreviation: AUDIT, Alcohol Use Disorders Identification Test.
erved at 1 month with those not observed at 1 month, overall, and by treatment group (to assess whether unavailability for follow-up was differential by randomization group). These analyses were repeated for those not observed at 6 months as well as for those not observed at either 1 month or 6 months. While nondifferential missingness of baseline quantities by randomization group does not rule out nonignorable differential missingness, it does provide some reassurance that the unobserved participants do not drastically differ from the observed.

We fit 2 types of models to assess an intention-to-treat hypothesis (randomization effect on outcome). Random-effects models allow the incorporation of all participants with at least 1 follow-up observation. This model will yield unbiased estimates of the treatment effect under the assumption that values are missing at random. Also, we carried out a sensitivity analysis using multiple imputation. A chained equation imputation model was fit simultaneously for all outcomes as well as baseline AUDIT score, age, and sex, to create 15 imputed complete data sets. Predictive mean matching was used within the mice/uvis routines in Stata while micombine was used to summarize the results. Values were imputed for all participants in the control group (65%) and 811 in the intervention group (77%). At 6 months, data were obtained from 767 participants in the control group (80%), and 962 in the intervention group (65%). A summary of participants who completed the screening survey, 5623 (66%) did not respond, 140 (1%) provided an incomplete response, and 7237 (56%) completed the screening survey. Of these, 4802 (66%) screened negative and 2435 (34%) screened positive for unhealthy alcohol use and were randomized to the intervention (n=1251) or the control (n=1184) group. The median completion time for the baseline questionnaire was 5.2 minutes (interquartile range, 4.0-7.0 minutes). Table 1 presents summary data illustrating the profile and equivalence of the 2 study groups at baseline.

**RESULTS**

**SCREENING AND RANDOMIZATION**

Participant flow, follow-up rates, and number analyzed are represented in the Figure. Of 13,000 students invited to complete the screening survey, 5623 (43%) did not respond, 140 (1%) provided an incomplete response, and 7237 (56%) completed the screening survey. Of these, 4802 (66%) screened negative and 2435 (34%) screened positive for unhealthy alcohol use and were randomized to the intervention (n=1251) or the control (n=1184) group. The median completion time for the baseline questionnaire was 5.2 minutes (interquartile range, 4.0-7.0 minutes). Table 1 presents summary data illustrating the profile and equivalence of the 2 study groups at baseline.

**FOLLOW-UP ASSESSMENT**

At 1 month, data were obtained from 942 participants in the control group (80%), and 962 in the intervention group (77%). At 6 months, data were obtained from 767 participants in the control group (65%) and 811 in the intervention group (65%). A summary of participants who were unavailable for follow-up by treatment group, age, sex, and AUDIT scores is presented in Table 2. Baseline AUDIT scores were similar for those who did or did not complete the follow-up assessment at 1 month (mean difference, 0.23 points; 95% confidence interval [CI], −0.26 to 0.72) and 6 months (mean difference, 0.03 points; 95% CI, −0.39 to 0.46). Men were more likely than women to be missing at 1 month ($\chi^2=5.9; P=.02$) and 6 months ($\chi^2=3.9; P=.05$). Those who dropped out were significantly older than those who continued at 1 month (mean difference, 0.29 years; 95% CI, 0.11 to 0.46) and 6 months (mean difference, 0.32 years; 95% CI, 0.17 to 0.47). The median time to follow-up was 3 days (interquartile range [IQR], 11 days) in each of the study groups at 1 month. At 6 months, it was 4 days (IQR, 8 days) in the control group and 4 days (IQR, 11 days) in the intervention group. Table 3 presents summary data for the outcomes at the 1- and 6-month follow-up assessments in each treat-

**Table 3. Summary Outcome Data 1 and 6 Months After Intervention**

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Control Group</th>
<th>Intervention Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency of drinking (No. of drinking days)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 mo</td>
<td>7 (4-11)</td>
<td>6 (4-10)</td>
</tr>
<tr>
<td>6 mo</td>
<td>8 (5-12)</td>
<td>7 (4-12)</td>
</tr>
<tr>
<td>Typical occasion quantity (No. of drinks per typical drinking occasion)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 mo</td>
<td>6 (4-10)</td>
<td>6 (4-9)</td>
</tr>
<tr>
<td>6 mo</td>
<td>6 (4-10)</td>
<td>6 (3-9)</td>
</tr>
<tr>
<td>Volume consumed (No. of drinks per week)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 mo</td>
<td>10 (6-19)</td>
<td>8 (4-15)</td>
</tr>
<tr>
<td>6 mo</td>
<td>11 (6-20)</td>
<td>9 (5-18)</td>
</tr>
<tr>
<td>Personal, social, sexual, and legal consequences of episodic heavy drinking (No. of problems; APS score: range, 0-14)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 mo</td>
<td>2 (1-4)</td>
<td>2 (1-4)</td>
</tr>
<tr>
<td>6 mo</td>
<td>2 (1-4)</td>
<td>2 (1-4)</td>
</tr>
<tr>
<td>Consequences related to academic role expectations (AREAS score: range, 0-15)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 mo</td>
<td>1 (0-2)</td>
<td>1 (0-2)</td>
</tr>
<tr>
<td>6 mo</td>
<td>1 (0-2)</td>
<td>1 (0-2)</td>
</tr>
<tr>
<td>Proportion exceeding guidelines for binge drinking (risk of acute harm), %</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 mo (control group, n=944; intervention group, n=966)</td>
<td>58.6</td>
<td>54.1</td>
</tr>
<tr>
<td>6 mo (control group, n=767; intervention group, n=813)</td>
<td>54.5</td>
<td>52.9</td>
</tr>
<tr>
<td>Proportion exceeding guidelines for heavy drinking (risk of chronic harm), %</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 mo (control group, n=944; intervention group, n=966)</td>
<td>22.1</td>
<td>15.1</td>
</tr>
<tr>
<td>6 mo (control group, n=767; intervention group, n=813)</td>
<td>25.0</td>
<td>18.7</td>
</tr>
<tr>
<td>Subjective treatment effects and help-seeking behavior (assessed at 6 mo only), %</td>
<td></td>
<td></td>
</tr>
<tr>
<td>“As a consequence of THRIVE the amount of alcohol I consume has decreased.”</td>
<td>5.8</td>
<td>19.0</td>
</tr>
<tr>
<td>“I have sought support to reduce my drinking as a consequence of THRIVE.”</td>
<td>2.7</td>
<td>4.9</td>
</tr>
</tbody>
</table>

Abbreviations: APS, Alcohol Problems Scale; AREAS, Academic Role Expectation and Alcohol Scale; THRIVE, Tertiary Health Research Intervention Via Email.

a All measures use the preceding 4 weeks as the reference period.
b Australian National Health and Medical Research Council: no more than 4 drinks (40 g of ethanol) on any 1 occasion for women, and no more than 6 drinks (60 g of ethanol) on any 1 occasion for men.

c No more than 14 drinks (140 g of ethanol) per week for women, and no more than 28 drinks (280 g of ethanol) per week for men.

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ment group and a summary of subjective treatment effects and help-seeking behavior. Intervention group participants were significantly more likely than controls to report subjective treatment effects ($\chi^2=62.9; P<.001$) and help-seeking behavior ($\chi^2=5.2; P=.02$).

**Table 4** presents treatment effect ratios for the outcomes at 1 and 6 months, with and without multiple imputation for missing values. At 1 month, relative to controls, participants receiving e-SBI reported a lower frequency of drinking (rate ratio [RR], 0.89; 95% CI, 0.83 to 0.94), fewer drinks per occasion (RR, 0.93; 95% CI, 0.88 to 0.98), and lower total consumption (RR, 0.83; 95% CI, 0.78 to 0.90). The differences in logAPS (RR, −0.02; 95% CI, −0.08 to 0.05) and AREAS score (RR, 0.94; 95% CI, 0.82 to 1.07) were nonsignificant.

At 6 months, the differences in frequency of drinking (RR, 0.91; 95% CI, 0.85 to 0.97) and total consumption (RR, 0.89; 95% CI, 0.82 to 0.96) remained. The other differences favored intervention (ie, risk ratios <1) but were nonsignificant. The $P$ values for the tests of intervention with 2 df vs control were $P<.001$, $P=.02$, and $P<.001$ for the primary outcomes. They were $P=.59$ and $P=.87$ for the alcohol-related problems measures (APS and AREAS). These results show that there were significant differences between the intervention and control groups for the primary outcomes across both follow-up assessments. Table 4 also includes treatment effect estimates after imputation for missing values.

There were nonsignificant differences between the intervention and control groups in the proportion who reported binge drinking at both follow-up assessments (Table 4). There were large significant differences in the proportion of participants who exceeded heavy drinking guidelines at 1 month (RR, 0.50; 95% CI, 0.35-0.71) and 6 months (RR, 0.55; 95% CI, 0.38-0.80), favoring the intervention. $P$ values for the tests of intervention with 2 df vs control were $P=.22$ and $P<.001$ for binge and heavy drinking guidelines, respectively.

Interaction terms were fitted in all models to determine whether the efficacy of the intervention varied between the 1- and 6-month follow-up periods. None of them was statistically significant. Interaction term $P$ values for the 7 outcomes in Table 4 were 0.47, 0.19, 0.13, 0.87, 0.69, 0.44, and 0.68, respectively.

**COMMENT**

Heavy drinkers who received the e-SBI drank 17% less alcohol than controls 1 month after screening and 11% less alcohol 6 months after screening. These differences in overall volume consumed were mainly driven by re-
ductions in the frequency of drinking, although there were also small reductions in the amount consumed per drinking episode. There were small nonsignificant differences between groups in the incidence of acute alcohol-related problems. In addition to the direct effects of the intervention, participant self-report after the 6-month follow-up period suggests that the intervention prompted students with unhealthy alcohol use to seek help to moderate their drinking. Despite attenuation in the size of the treatment effect ratios from 1 to 6 months after intervention, fitting of interaction terms in statistical models showed that the efficacy of the intervention did not differ significantly between the follow-up assessments.

Attrition at 1 month (22%) and 6 months (35%) was higher than in previous studies of e-SBI with university students using a primary health care facility (10% and 15%, respectively).²⁰ The difference may reflect less commitment to the study in the absence of a face-to-face interaction with a researcher. Importantly, those students who were unavailable for follow-up were similar across treatment groups with regard to sex, age, and baseline AUDIT score. The sensitivity analysis, using multiple imputation to include all cases in the analyses, produced modest attenuation in treatment effect ratios (Table 4). While these analyses do not rule out possible nonignorable nonresponse as a cause of the results, this explanation is implausible given the nondifferential dropout.

A previous study using a similar e-SBI instrument found evidence of an assessment effect, ie, students with unhealthy alcohol use who received 10 minutes of Web-based assessment of their drinking, in the absence of a feedback intervention, subsequently drank less than a healthy alcohol use who received 10 minutes of Web-based assessment of their drinking, in the absence of a feedback intervention, subsequent drank less than a healthy alcohol use who received 10 minutes of Web-based assessment of their drinking. The evidence of an assessment effect, ie, students with unhealthy alcohol use who received 10 minutes of Web-based assessment of their drinking, is similar to that reported in a recent systematic review of conventionally delivered primary health care–based brief interventions (13%).³⁵ Given the scale on which proactive e-SBI can be delivered and its acceptability to student drinkers, we can be optimistic that a widespread application of this intervention would produce a benefit in this population group. The e-SBI, a program that is available for nonprofit purposes, could be extended to other settings, including high schools, general practices, and hospitals.

Accepted for Publication: May 23, 2009.
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Financial Disclosure: None reported.

Funding/Support: This study was funded in part by grant 15166 from the Western Australian Health Promotion Foundation (Healthway).

Role of the Sponsor: The sponsor had no involvement in any aspect of the study or reporting of findings.

Additional Contributions: John Saunders, MD, and Jim McCambridge, PhD, generously provided comments on a draft of the article.

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