Internet-based interventions for young people with problematic substance use: a systematic review

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ABSTRACT

Objective: To conduct a systematic review of randomised trials of web-based interventions for problematic substance use by adolescents and young adults.

Data sources: An extensive search conducted in February 2009 of computer databases (MEDLINE, PsycINFO, Current Contents) and manual searches of key references.

Study selection: Randomised comparisons of fully automated web-based interventions specifically targeting adolescents and young adults (ie, typically school or tertiary students, ≤25 years old) versus other interventions.

Data synthesis: 16 relevant studies were identified, and data were extracted from 13 of the 14 reporting on alcohol use by young adults. The alcohol interventions had a small effect overall (d = −0.22) and for specific outcomes (level of alcohol consumption, d = −0.12; binge or heavy drinking frequency, d = −0.35; alcohol-related social problems, d = −0.57). The interventions were not effective (d = −0.001) in preventing subsequent development of alcohol-related problems among people who were non-drinkers at baseline. Due to methodological differences, data from the two studies reporting on tobacco interventions among adolescents were not combined.

Conclusions: Based on findings largely from tertiary students, web interventions targeting alcohol-related problems have an effect about equivalent to brief in-person interventions, but with the advantage that they can be delivered to a far larger proportion of the target population. Web-based interventions to prevent the development of alcohol-related problems in those who do not currently drink appear to have minimal impact. There are currently insufficient data to assess the effectiveness of web-based interventions for tobacco use by adolescents.
From a population perspective, for prevention programs to be useful in reducing health problems, they must not only have demonstrated efficacy and effectiveness but also the potential to be scalable, as well as having available resources to allow the program to be widely replicated while maintaining treatment fidelity.\(^1\)\(^8\) We therefore restricted our focus to include only interventions that used fully automated treatment programs and excluded those that required additional elements, such as in-person motivational interviews, due to the difficulty of delivering these at a population level. Interventions delivered via a stand-alone computer or CD-ROM were similarly excluded.

### Data analysis

To avoid overestimating the magnitude of effects in studies with measured improvements, effect sizes (\(d\)) were calculated as between-group differences at follow-up divided by the pooled standard deviation from the baseline data.\(^1\)\(^9\) Where baseline data were unavailable, pooled standard deviations from the outcome results were used. In studies reporting medians and ranges, we estimated means and standard deviations using the method of Hozo and colleagues.\(^2\)\(^0\)

Data were combined using Meta-Analysis software, version 5.3 (Ralf Schwarzer, Berlin, Germany), employing a random effects model. Where outcomes were significantly heterogeneous, the cluster analysis software incorporated in the same program was used to identify potential outliers.

### RESULTS

#### Young adults

The search strategy yielded 13 studies involving tertiary students and one with young employed adults (Box 1, pages S16–S17). All 14 studies targeted alcohol consumption, with one study also addressing other types of health behaviour (physical inactivity, low fruit and vegetable intake\(^1\)\(^7\)). One study provided outcome data as change scores subdivided by sex;\(^3\)\(^2\) we did not include these in the meta-analysis phase.
The overall effect size for the outcomes (summarised in Box 2, pages S18–S19) was $d = -0.22$ (SE, 0.06; 95% CI, −0.34 to −0.10), but with significant heterogeneity ($Q = 249.03, df = 55, P < 0.0001$). In light of the range of different types of outcome measures used and the different levels of baseline alcohol exposure, potential sources of heterogeneity were sought by separately analysing the results for three key outcome measures: frequency of heavy or binge-drinking events, alcohol-related problems, and academic problems. Both alcohol-related and academic problems showed significant heterogeneity ($Q = 29.74, df = 6, P = 0.00004$). An inspection of a cluster plot showed the effects for the studies of Bersamin et al.21 ($d = -0.99$) and Kypri et al.27 ($d = -0.80$) to be outliers.

Six studies reported on alcohol-related social consequences, as assessed by measures such as the Rutgers Alcohol Problem Index36 or Alcohol Problems Scale37 (Box 2; variables 3, 21, 30, 38, 52, 55), with the overall effect size being $d = -0.57$ (SE, 0.21; 95% CI, −0.98 to −0.15). These data showed significant heterogeneity ($Q = 24.20, df = 5, P = 0.0002$). A cluster analysis identified three clusters, with the smallest (variable 61) and largest (variable 38) effect sizes separate from the remaining variables.

Two studies reported outcomes separately for those who were non-drinkers at baseline.21,24 The overall effect for this subpopulation was $d = -0.001$ (SE, 0.06; 95% CI, −0.12 to 0.12), an effect not significantly different from zero ($Z = -0.016; P = 0.499$). Our analysis did not include 751 people in Croom et al.46 study who were non-drinkers at baseline and follow-up, as disaggregated data were not available for these people. The overall effect size for all participants in the study, regardless of baseline alcohol status, was $d = -0.02$.24

### Adolescents

Our systematic search yielded two eligible studies targeting adolescents (Box 3). Both studies targeted adolescent smoking: one randomly assigned schools to intervention or control groups,38 and the second used
Due to these methodological differences and differences in the target populations (all students vs only smokers), these data were not combined for meta-analysis.

**DISCUSSION**

Our search strategy revealed two categories of web-based intervention for problematic substance use in young people. Web-based interventions targeting alcohol use by young adults, predominantly tertiary students, appear to be effective for alcohol problems in current drinkers, but there is insufficient evidence to support their use in preventing the development of alcohol-related problems among those who do not drink alcohol. The second category was web-based interventions addressing smoking cessation in adolescents and school children; however, there are currently insufficient data to assess the utility of such interventions in this group.

Brief in-person interventions for non-treatment-seeking individuals are an effective means of reducing alcohol consumption, with effect sizes in the range of 0.14 to 0.67 (with positive values showing better outcomes). Brief interventions have also been found to be effective among adolescents, with an overall effect size of 0.275. Thus, the effects reported here for web-based interventions targeting alcohol use by young adults, predominantly tertiary students, appear to be effective for alcohol problems in current drinkers, but there is insufficient evidence to support their use in preventing the development of alcohol-related problems among those who do not drink alcohol.
2 Outcome measures and effect sizes of interventions for problematic substance use in young adults (continued)

<table>
<thead>
<tr>
<th>Study</th>
<th>Outcome samples</th>
<th>n_e, n_c</th>
<th>Variable</th>
<th>Outcome measure</th>
<th>Mean_{e}, mean_{c} / baseline SD_{e}, SD_{c} (or outcome SD_{e}, SD_{c})</th>
<th>Effect size {d}</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kypri and McAnally^{27}</td>
<td>65, 61</td>
<td>33</td>
<td>Peak estimated BAC</td>
<td>0.12, 0.13 / (0.12, 0.08)</td>
<td>-0.10</td>
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<tr>
<td>Kypri et al^{29}</td>
<td>47, 47</td>
<td>33</td>
<td>Drinking days past 2 weeks</td>
<td>3.4 / (2.3, 5)</td>
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<tr>
<td></td>
<td></td>
<td>34</td>
<td>Drinks per drinking occasion</td>
<td>8, 8 / (5, 6.29)</td>
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<td></td>
<td></td>
<td>36</td>
<td>Total drinks past 2 weeks</td>
<td>26, 23 / (18.75, 31.25)</td>
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<td>37</td>
<td>Heavy drinking (female &gt; 80 g; male &gt; 120 g) past 2 weeks</td>
<td>1, 1 / (1, 3)</td>
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<td></td>
<td></td>
<td>38</td>
<td>APS (social)</td>
<td>2, 3 / (0.5, 0.75)</td>
<td>-1.57</td>
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<td></td>
<td></td>
<td>39</td>
<td>Alcohol problems (academic)</td>
<td>2, 4 / (3.0, 4.25)</td>
<td>-0.54</td>
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<tr>
<td>Moore et al^{30}</td>
<td>53, 47</td>
<td>40</td>
<td>Frequency/year</td>
<td>3.36, 3.60 / 2.04, 1.99</td>
<td>-0.12</td>
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<tr>
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<td>41</td>
<td>Frequency/month</td>
<td>3.68, 5.02 / 5.82, 5.83</td>
<td>-0.24</td>
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<tr>
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<td></td>
<td>42</td>
<td>Quantity/month</td>
<td>2.53, 2.51 / 2.55, 2.61</td>
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<td>43</td>
<td>Binge (female &gt; 4; male &gt; 6)/2 weeks</td>
<td>0.83, 1.34 / 1.60, 1.58</td>
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<td>44</td>
<td>Binge (female &gt; 4; male &gt; 6)/month</td>
<td>1.64, 2.21 / 3.69, 3.76</td>
<td>-0.15</td>
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<td>45</td>
<td>“Get drunk” quantity</td>
<td>1.38, 1.98 / 2.84, 2.81</td>
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<td>46</td>
<td>“Get drunk” frequency</td>
<td>2.94, 2.96 / 4.51, 4.52</td>
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<td>47</td>
<td>Peak quantity/month</td>
<td>4.25, 4.57 / 5.31, 5.28</td>
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<td>Neighbors et al^{31}</td>
<td>138, 144</td>
<td>48</td>
<td>Quantity on 21st birthday</td>
<td>6.40, 7.00 / 5.29, 5.12</td>
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<td></td>
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<td>49</td>
<td>Estimated BAC</td>
<td>0.099, 0.129 / 0.107, 0.107</td>
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<tr>
<td>Walters et al^{33}</td>
<td>54, 61</td>
<td>50</td>
<td>Drinks/week</td>
<td>12.07, 12.92 / 11.59, 12.89</td>
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<td>51</td>
<td>Estimated peak BAC</td>
<td>0.116, 0.135 / 0.088, 0.102</td>
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<td>52</td>
<td>Alcohol-related problems (RAPI)</td>
<td>3.72, 5.77 / 6.01, 6.35</td>
<td>-0.33</td>
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<tr>
<td>Walters et al^{34}</td>
<td>39, 43 (Week 16)</td>
<td>53</td>
<td>Drinks/week</td>
<td>3.17, 2.98 / 1.52, 1.35</td>
<td>0.13</td>
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<td></td>
<td>54</td>
<td>Peak BAC</td>
<td>0.052, 0.059 / 0.02, 0.01</td>
<td>-0.49</td>
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<tr>
<td></td>
<td></td>
<td>55</td>
<td>Alcohol-related problems (RAPI)</td>
<td>1.51, 1.72 / 0.49, 0.61</td>
<td>-0.38</td>
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<tr>
<td></td>
<td></td>
<td>56</td>
<td>Perceived drinking norms</td>
<td>10.3, 18.7 / 26.5, 3.42</td>
<td>-2.73</td>
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</table>

* e = experimental group. c = control group. APS = Alcohol Problems Scale.37 BAC = blood alcohol content. RAPI = Rutgers Alcohol Problem Index.36 § A third group received additional in-person feedback and is excluded.

Based interventions are consistent with the magnitude of effects obtained from in-person interventions. There is preliminary evidence that computer-based interventions are cost-effective (eg, compared with cognitive behaviour therapy for depression).31 There is also evidence to support the scalability of web-based interventions,42 a potential benefit compared with in-person interventions. Nevertheless, it should be noted that some of the interventions reviewed here21,24 are more time-consuming than typical brief in-person interventions, which are designed to be delivered in less than four sessions.8 Cost–benefit analyses comparing web-based with in-person interventions are required.

An important caveat must be noted. In general, the web-based interventions in this review reported short-term outcomes, usually 3 months or less, and these may not represent a meaningful change in behaviour. Only four studies reported outcomes for 4 months or longer.27,29,33,34 The outcomes for these studies (Box 2) show effect sizes ranging from 0.12 to ~2.73, suggesting that persistent change in behaviour is possible with web-based interventions. Nevertheless, confirmation of long-term impacts is needed.

Considerable heterogeneity was noted in many of the measures and across the studies. Inspection of the interventions and measures did not reveal any clear explanation for this. For example, the measure of heavy drinking in Kypri et al’s 2008 study27 that was identified as an outlier in our sub-analysis was the same measure used in their 2004 study.29 with both studies using similar interventions and similar target populations (tertiary students recruited in a health care setting). Additionally, although the target populations across all but one of the alcohol interventions16 were tertiary students, the study samples included subgroups of this population ranging from non-drinkers at baseline21 to students who had been referred for counselling after breaches of university alcohol or drug policies.23 Furthermore, both Bersamin et al21 and Croom et al24 noted that the web interventions were ineffective with young people who were non-drinkers at baseline — findings confirmed by the combined data reported here. Although all the studies used randomised designs, there was considerable diversity in the intensity of the interventions delivered, ranging from an online course24 to a 15-minute assessment and feedback session.25 Finally, not all studies provided a control group with an intervention of similar intensity as the experimental intervention. Therefore, it is unsurprising that there were overall differences in the effectiveness of interventions or the effect sizes.

A previous review of brief interventions to reduce smoking in adolescents noted an effect size of 0.037.40 This included inter-
ventions delivered at the population level and for existing smokers. Our review also identified one population-level approach and one targeting existing smokers. The population-level intervention recruited participants in both Australia and the United States. The Australian arm of the study reported a lower prevalence of smoking in the intervention group compared with the control group and a lower level of initiation of smoking by non-smokers. However, these findings were not replicated in the US sample, and the authors concluded that web-based interventions are likely to have little practical impact on the level of smoking by adolescents.

Another review estimated that the overall quit rate for stand-alone computer-based smoking-cessation interventions for adolescents was 13%. Patten et al reported that none of the adolescents in their study attained complete abstinence, but the 30-day abstinence level at 36 weeks was 13% for brief office-based intervention, compared with 6% for the web-based intervention. A potential reason for the poor performance of the web-based approach is that participants accessed the website from home (on a mean of 6.8 days over 24 weeks), with 86% visiting the site at least once, but less than a third visiting the site weekly after the third week. In contrast, delivery in a school setting may encourage greater compliance (eg, 77% completing all sessions). 90% completing two of three sessions). Therefore, motivation of adolescents and compliance may be key factors in the effectiveness of this form of intervention.

Our review has some potential limitations. The techniques and process of meta-analysis have received detailed and at times trenchant critiques, with key concerns being the quality of the studies included (‘garbage in, garbage out’), combining different measures or interventions (“apples and oranges”), including multiple measures from studies (“inflated Ns”) and publication bias (“file drawer problem”). Nevertheless, the systematic assembly of data fulfilling clear criteria has come to the forefront in summarising scientific evidence.

Further, we did not identify any studies on the effectiveness of web-based interventions with adolescent drinkers. Given that 70% of 17-year-old students report having used alcohol in the past month and more than 40% report using it in a risky fashion, this would appear to be an important target for future research, even though it is difficult to obtain the necessary ethics approval to conduct research in this age group, especially when investigating interventions to convert behaviour.

Adolescence and young adulthood are the key period for initiation of substance use and the development of substance use disorders. Although the lifetime prevalence of licit drug use has remained stable, the age of initiation has fallen in more recent birth cohorts, with a concomitant increase in the risk of developing disorders in later life. Thus, there is an imperative to design and deliver interventions that address substance use by adolescents and young adults. Web-based interventions have the potential to provide interventions at a population level, with initial findings supporting their effectiveness in reducing problematic alcohol use in tertiary students and young adults.

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COMPETING INTERESTS
None identified.

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