College Smoking-Cessation
Using Cell Phone Text Messaging

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Abstract. Although rates of smoking among college-aged students continue to rise, few interventions that focus on college smokers' unique motivations and episodic smoking patterns exist. The authors developed and evaluated a prototype program targeting college students that integrates Web and cell phone technologies to deliver a smoking-cessation intervention. To guide the user through the creation and initialization of an individualized quitting program delivered by means of cell phone text messaging, the program uses assessment tools delivered with the program Web site. Forty-six regular smokers were recruited from local colleges and provided access to the program. At 6-week follow-up, 43% had made at least one 24-hour attempt to quit, and 22% were quit-based on a 7-day prevalence criterion. The findings provide support for using wireless text messages to deliver potentially effective smoking-cessation behavioral interventions to college students.

Key Words: cell phones, college students, communication technologies, smoking cessation, text messaging

Significant progress has been made in reducing the overall prevalence of smoking in the United States, yet rates of smoking among college-aged adults (18–24 years of age) increased by more than 25% from 1993 to 1997. In a national survey of college smoking, Rigotti and associates found that 46% had used a tobacco product in the past year and one third were current tobacco users. Current cigarette smoking rates were comparable for men and women (28%), but rates were significantly higher for tobacco use among men (38%) than among women (30%) because of men's greater prevalence of cigar and smokeless tobacco use. We concluded that the use of a wide range of tobacco products is common among college students and increases their risk of developing lifelong dependence on nicotine. Other prevalence studies of college students have reached similar conclusions about the high and increasing rate of smoking in this population.

College students represent a transitional development period between adolescence and adulthood that is reflected in the varied causes and patterns of smoking found in this population. These young adult smokers are more similar to adolescent smokers than to older smokers, in both the patterns of smoking and in the factors that influence their smoking behavior. For example, occasional or episodic smoking is much more prevalent among college smokers than among older adults and is more influenced by specific environmental triggers, such as the use of alcohol or the presence of smoking friends. Peer influence and social factors for smoking are prominent in this age group, but parents also continue to play an important role. College smoking is particularly associated with the use of other substances, including alcohol and marijuana. Any tobacco-control effort with this population must provide a flexible combination of smoking interventions typically applied to adults and to adolescents as a way of addressing the unique needs of college smokers.

The increasing prevalence of smoking in college students and the unique issues that must be addressed with this group have resulted in a greater demand for smoking-cessation interventions specifically targeting college smokers. Although college smokers appear to have less interest in quitting than older smokers do, from one third to half of current college smokers report a serious desire to quit, and half to three quarters have attempted to quit in the past. DeBernardo and associates found that "cold turkey" was the preferred method of quitting among college smokers and that a majority did not want professional assistance to stop
their smoking. These findings parallel those of Balch, who found that adolescent smokers were unlikely to engage in any formal smoking-cessation intervention, particularly group-based interventions sponsored by the school. Therefore, although college students appear to be sufficiently interested in quitting, they are unlikely to engage in formal or professionally provided interventions.

Despite the demand from public health officials for smoking-cessation interventions that target college students, few interventions specifically aimed at college smokers have been evaluated to date. O’Neill and associates recently evaluated 2 PC-based computer smoking-cessation programs with college smokers. Both programs (stage-based and health-education based) produced point prevalence abstinence of 30% and continuous abstinence of 14% to 19% at 6-month follow-up. This paucity of smoking-cessation research with college students is paralleled by the lack of empirically based cessation methods for adolescent smokers. Recent reviews of adolescent cessation and prevention strategies have concluded that the few studies available provide little direction for successful cessation programs.

**Program Description**

The purpose of the project described in this article was to develop and test the feasibility of an integrated Web and text-messaging program for smoking cessation that is based on behavioral self-regulation theory. The program created a unique, individually tailored smoking-cessation program delivered to the participant by text messages to the participant’s cell phone. The program was developed from information about their smoking habits and patterns that we obtained through assessment questions participants answered on the Web site. The program also provided a social support component that allowed selected others to follow the smoker’s progress on the Web site and send additional text messages encouraging the smokers in their progress in quitting. Once successful smoking cessation had been achieved, the program provided interactive, real-time relapse prevention strategies.

**Web Site Components**

**User Registration and Program Initialization**

Users register for and initiate the program from a Web site dedicated to providing the wireless program. Upon accessing the Web site, users are prompted to enter contact information and information about their cell phones; they are then guided through a series of questions designed to tailor the program to themselves. This initial assessment asks about basic smoking history, high-risk craving situations, motivation, and self-efficacy to quit. Users are asked to select the situations in which they typically smoke. For example, they are given examples (e.g., leaving class, while studying, while drinking at a bar), then asked to rate these situations for their risk of smoking and for their typical days and times of occurrence.

After they have completed the personalized entries, the users are prompted to select a quit date, and the program is initiated on the user’s cell phone.

**Web Site Feedback**

Although text messaging is the main element of the program, the Web site also provides ongoing feedback to the users, who can visit the Web site to view a log of all text messages sent during the program and can receive any messages that have been sent by personal support people. Users are encouraged to visit the Web site daily to note the number of cigarettes they have smoked each day during the preparation stage. They are then able to view a graph indicating the number of cigarettes smoked each day since the program began. The Web site also provides several educational modules on topics such as handling withdrawal, coping with urges, and controlling weight.

**Support Persons**

Users have the option of specifying support persons for their program. If they wish to do so, they create a user name and password for the support person, who is then able to log on to the Web site to view the user’s progress in giving up smoking. E-mail messages prompt the support person to leave messages to encourage the user’s progress and use of educational modules available to provide assistance to the support person with tips on how to encourage and support the individual in carrying the program through.

**Text Messaging Components**

**Initial Text Message.** Once the participants initialize the program on the Web site, an initial text message asks users to reply in the body of the message to confirm that they have correctly received the message.

**Preparation Period.** During the preparation period, the users are contacted by text messaging with increasing frequency as they approach the chosen quit date. The users are provided with coping messages that are timed to high-risk situations and times of occurrence that the user has specified. These messages are sent to provide the user with suggestions appropriate to the probable high-risk situation. For example, if a user indicated that he or she typically smoked after finishing breakfast at 9 AM every morning, the program might send a message at that time saying, “If you typically experience cravings after breakfast, try getting up from the table and taking a walk.” Users are also able to send an SOS text message that indicates to the program that they are in a situation in which they crave a cigarette. As the quit date approaches, the users are sent text messages encouraging them to experiment with refraining from smoking in specific situations as preparation for quitting. These messages also include reminders about the chosen quit date and how many days remain. In addition to the coping interventions provided directly by wireless messaging, the user is also encouraged to call a support person or seek additional assistance on the Web site if the
automated intervention alone is insufficient to help handle the craving to smoke.

**Quit Day.** On the chosen quit day, the program sends a text message to the user at times that were anticipated to have the greatest likelihood of smoking based on the information gathered earlier. Their primary purpose is to encourage the user to remain abstinent through the first day and to provide assistance with withdrawal symptoms as well as coping strategies for handling cravings in specific situations. In addition to these scheduled contacts, users can communicate with the system if they want specific assistance in a high-risk situation.

**Quit Maintenance and Relapse Prevention.** On all subsequent days of abstinence, the user receives at least 2 text messages. To keep these multiple contacts from becoming too intrusive, users are able to indicate near the beginning of the interactive message that they are doing all right at this time and need no additional assistance, thereby ending the contact quickly. The user sets a “start of day” contact each day for the subsequent day that provides a general reminder about the number of days since quitting and encourages him or her to remain abstinent that day. To avoid habituation to the standard message, a number of varied messages are produced and selected randomly for transmission. A second contact is based on the time when the user anticipated the greatest high-risk situation for that day.

**METHOD**

**Participants**

We recruited 46 college students aged 18 to 25 years from local college campuses in the greater Washington, DC area, using informational tables set up at the schools’ student centers. Screening inclusion criteria for the study included the following:

- Age 18 to 25 years and a current college student
- Own and regularly use a cell phone with text messaging capabilities
- Self-report a minimum of 28 cigarettes smoked per week (average 4/d) and smoking on at least 6 of 7 days each week (allowing for the variability of college smokers and requiring a frequency of smoking consistent with a need for quitting assistance)
- Desire to quit smoking in the next 30 days (preparation phase)
- No current ( > 3/wk) use of other tobacco products
- No current use of nicotine replacement treatment or bupropion in the past month
- Not in treatment for any substance abuse disorder within the past year.

Participants attended the following colleges: George Mason University (33, 72%), American University (6, 13%), George Washington University (5, 11%), and Northern Virginia Community College (2, 4%). The sample was 54% (25) male and 46% (21) female with the following racial groups represented: White (33, 72%), Asian (7, 15%), African American (3, 7%), White Hispanic (1, 2%), American Indian (1, 2%), and Pacific Islander (1, 2%). Their ages ranged from 18 to 25 years (M = 19.9y, SD = 1.5y). A majority of the participants were full-time students (33, 72%), and half (23, 50%) lived off-campus.

**Measures**

After giving informed consent, the participants completed a number of self-report smoking measures at pretest and 6 weeks later at posttest. These measures included 7-day smoking reconstructions, the Nicotine-Dependence Syndrome Scale (NDSS), and a program-use questionnaire we devised for this project.

**Seven-day Reconstructions**

Participants completed a 7-day smoking-reconstruction form that followed the timeline follow-back (TLFB) method at the beginning of the study, at midpoint (3 weeks later), and at the end of the study (6 weeks later). The TLFB method was originally devised to determine a pattern of alcohol consumption; it has shown high test-retest reliability in treatment and research settings. Participants use a blank calendar to help guide them to reconstruct events that occurred during the specified timeframe. Participants are prompted to note national holidays, news, and personal events. They are then asked to fill in their alcohol consumption at the time of these events. The TLFB has been used to assess smoking patterns.

For our study, we used the TLFB method to reconstruct participants’ smoking for the past 7 days. The research staff communicated with participants by telephone and helped them reconstruct events that occurred during the previous week; they were then able to work backward from the current day to recall the number of cigarettes smoked each day for the past 7 days. We used these data to determine reductions in cigarette smoking during the study period. In addition, we obtained saliva samples for biochemical validation of smoking abstinence if the posttest 7-day reconstruction indicated abstinence.

**Nicotine-Dependence Syndrome Scale**

Participants completed the NDSS questionnaire at the beginning and end of the study. We chose to use the NDSS, a new, unpublished measure, instead of the more commonly used Fagerstrom Test for Nicotine Dependence because the NDSS does not use smoking rates as an indicator of nicotine dependence. The NDSS has been administered in a number of studies and has shown promising psychometric properties. It is a 19-item scale with the following subscales: (1) Drive (craving and withdrawal symptoms), (2) Priority (behavioral preference of smoking over other reinforcers), (3) Tolerance (reduced sensitivity to smoking’s effects), (4) Continuity (regularity of smoking), and (5) Stereotypy (smoking pattern invariance). These questionnaire items provide statements about nicotine dependence symptoms that the respondent must indicate are not at all true (1) to extremely true (5).
Program Use Questionnaire

We administered a shortened form of this questionnaire to participants over the telephone at their 3-week call to determine whether program components were being used and to provide assistance with any problems. We administered the full questionnaire at the 6-week study point. This questionnaire asked respondents about their use of program components, their success in quitting, and their satisfaction with the program. Responses were on a 5-point rating scale from strongly disagree (1) to strongly agree (5).

Procedures

The research staff performed initial screening at informational tables on campuses. Participants completed the baseline measures, including the first 7-day reconstruction, and we gave them instructions to register on the study Web site to personalize and initialize their smoking intervention program.

Three weeks after entering the program, we communicated with the participants by telephone and asked them to complete another reconstruction of their smoking during the previous week. During this interview, we also asked the participants about their experience with the program, using a limited version of the program-use questionnaire administered at posttreatment.

At the end of the 6-week study period, we telephoned participants and asked them to complete the third 7-day smoking reconstruction and inquire about any quit attempts they made during the study period. We obtained saliva samples by mail from participants who reported that they had stopped smoking. The staff of J2 Labs analyzed these samples for saliva cotinine levels. We considered cotinine levels of \( \leq 15 \text{ ng/ml} \) valid for smoking abstinence. We also mailed posttest measures to the participants to complete and mail back. We paid participants $50 for completing all the measures and paid an additional $25 to those who provided saliva cotinine samples.

We used SPSS for all statistical analyses. Because our feasibility study was exploratory, many analyses were descriptive. The outcomes assessment included percentages of participants who made a 24-hour attempt to quit smoking, percentages of participants who had quit at the end of the 6-week program, and participants’ ratings of the smoking-cessation program. We computed paired sample \( t \)-test statistics on all repeated parametric variables such as the NDSS scores and independent \( t \)-test statistics to compare quitters with nonquitters. We set significance at \( p < .05 \) unless indicated otherwise.

RESULTS

Of the 46 participants, 7 formally dropped out of the study and an additional 8 were lost to follow-up. We found no significant differences on the pretest measures between participants who completed the study and participants who dropped out. As appropriate, we performed analyses on the “intent to treat” sample (\( n = 46 \)), treating those who failed to complete the study as also failing to quit smoking.

Sample Characteristics

Baseline reports yielded the following information about frequency and regularity of smoking from the 46 participants: participants smoked between 28 and 200 cigarettes a week with an average of 71 cigarettes a week or approximately 10 cigarettes (half a pack) each day. Most participants (42, 91%) smoked every day of the week, although 4 (9%) reported smoking an average of 6 days a week.

The participants had tried many smoking-cessation methods in the past. The most common method was “cold turkey” (20, 74%), although participants also reported using nicotine gum (6, 22%), nicotine patches (3, 11%), and nicotine lozenges (2, 7%). They also reported trying self-help programs (6, 22%) and counseling (2, 7%). Five participants (18%) had never previously attempted to quit smoking.

Midpoint (3-week) Data

The research staff attempted to reach each participant at the 3-week point, and collected data from 24 participants about their smoking status and quitting intentions to that point (see Table 1). At the midpoint call, 8 participants (33% of contacted, 17% of total sample) reported they had quit smoking, and 16 participants reported they were still smoking. These 16 participants smoked an average of 64 cigarettes a week at pretest and reduced their consumption to an average of 32 cigarettes a week at midpoint (\( t = 4.29, p < .001 \)). The majority of these participants reported they were either actively trying to quit (4, 25%) or planning to quit within the next 3 weeks of the program (10, 63%).

<table>
<thead>
<tr>
<th>Participant</th>
<th>Quit (n)</th>
<th>Smoking less (n)</th>
<th>Actively trying to quit (n)</th>
<th>Planning to quit next 3 weeks (n)</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>8</td>
<td>11</td>
<td>4</td>
<td>10</td>
</tr>
<tr>
<td>Completed study</td>
<td>33</td>
<td>69 of those not quit</td>
<td>25 of those not quit</td>
<td>63 of those not quit</td>
</tr>
<tr>
<td>(n = 24%)</td>
<td></td>
<td>(n = 16)</td>
<td>(n = 16)</td>
<td></td>
</tr>
<tr>
<td>Intent-to-treat</td>
<td>17</td>
<td>29 of those not quit</td>
<td>11 of those not quit</td>
<td>26 of those not quit</td>
</tr>
<tr>
<td>(n = 46)%</td>
<td></td>
<td>(n = 38)</td>
<td>(n = 38)</td>
<td></td>
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</tbody>
</table>
(12%) reported they had no intention of quitting. We found no significant difference between the quitters and nonquitters on use of program components at midpoint.

**End of Study (6-week) Data**

During the 6-week study period, 29 of the 46 participants registered on the Web site. We called the 17 participants who did not register on the Web site several times to remind them to sign up, but they failed to do so; we later called them in a separate telephone interview to collect qualitative data on reasons for nonregistration.

**Quit Smoking Attempts**

We asked participants whether they had made a 24-hour quit attempt, about the length of their smoking abstinence, and about their lapses or relapses (see Table 2). We collected data from 31 of the participants at 6-week posttest. Twenty participants (65% of those contacted, 43% of the total) reported that they had made a 24-hour quit attempt during the study period, but 12 of these participants reported a relapse. The number of days of relapse varied between 1 day and 14 days. Fewer than half (5) of these participants then attempted another 24-hour quit; 2 of them had quit at the end of treatment call, whereas 2 had stopped smoking for a few days but did not meet the 7-day criterion. Therefore, 10 of the 46 (22%) intent-to-treat participants met the 7-day quit point criteria at the 6-week study point. We collected saliva cotinine samples and validated smoking abstinence for 8 of these participants. We did not receive samples from the other 2 participants who reported abstinence. When we used the more conservative criterion of reported quits with validated saliva cotinine samples, the quit rate was 17% (8/46). Of those who actually initiated the treatment program and received text messages, however, the validated quit rate was 28% (8/29), see Table 2.

**Smoking Reduction**

We collected 7-day reconstructions at pretest and posttest from 27 of the participants. As we previously noted, 10 of the 27 participants had quit smoking at posttest. Of the remaining 17 participants, 2 had not initiated the program and therefore did not receive text messages; we were able to reach 2 who had received the program but had not quit smoking. The remaining 15 participants smoked an average of 76 cigarettes per week at pretest and reduced their consumption to an average of 32 cigarettes per week at posttest ($t = 5.10$, $p < .001$).

**Nicotine-Dependence Syndrome Scale Scores**

For NDSS analysis, we examined data from the participants who had not quit smoking to assess changes in nicotine dependence. We did not analyze data from quitters because NDSS as a measure comprises only questions about the respondents’ current smoking habits and patterns. The mean overall dependence score reduced significantly from $-0.37$ to $-1.00$ ($t = 5.4$, $p < .001$). These findings indicated that among participants who did not quit, their dependence on nicotine decreased significantly during the study period.

**Program Use Questionnaire**

Participants gave moderately high scores to the ease of using the different program components, comfort in using the program components, and overall satisfaction with the program. Some significant differences in ratings emerged between the participants who quit and those who did not (see Table 3). As expected, the participants who had quit smoking gave comparatively higher scores for use of the text-messaging component as well as satisfaction with the program. However, among the participants who had not quit, 14 (78%) had already substantially reduced their smoking and were actively trying to quit, 2 (11%) were considering quitting in the next 90 days, and 2 (11%) had no intention of quitting.

Participants who failed to initialize the program but could later be reached for feedback provided qualitative comments on what they thought could be improved to encourage initializing the program. These 17 participants who did not register on the Web site most frequently indicated that it would have been much easier to register on the Web site if a computer had been available at the time they signed up for the program. Fifty percent of off-campus students in this sample may have had limited Web access. Despite failing to register, however, many indicated that they liked the program concept and thought the text messaging would have been effective had they been able to sign up.

Among the registered participants, many comments and suggestions provided insight into which components the

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**TABLE 2. End of Study (6 weeks) Data of Participants in a College Smoking-Cessation Text-Messaging Program**

<table>
<thead>
<tr>
<th>Participant</th>
<th>Quit (n)</th>
<th>24-hour quit attempt (n)</th>
<th>Relapsed (n)</th>
<th>Another quit attempt (n)</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Completed study (n = 31)%</td>
<td>10</td>
<td>20</td>
<td>12</td>
<td>5</td>
</tr>
<tr>
<td>(n = 31)</td>
<td>32</td>
<td>65 of those who</td>
<td>60 of those who</td>
<td>42 of those who</td>
</tr>
<tr>
<td></td>
<td></td>
<td>completed study</td>
<td>made quit attempt</td>
<td>relapsed (n = 12)</td>
</tr>
<tr>
<td>Intent-to-treat (n = 46)%</td>
<td>22</td>
<td>43 of intent-to-treat sample (n = 46)</td>
<td>26 of intent-to-treat sample (n = 46)</td>
<td>11 of intent-to-treat sample (n = 46)</td>
</tr>
</tbody>
</table>
objective ratings of success. Of all participants entered in the OBERMAYER ET AL study (A' = 46), nearly half (43%) reported a 24-hour quit attempt, and 22% had quit smoking after 6 weeks in the program rated it high on acceptability, satisfaction, and subjective ratings of success. Of all participants entered in the study (N = 46), nearly half (43%) reported a 24-hour quit attempt, and 22% had quit smoking after 6 weeks in the program (17% reported cotinine validation). Among those who actually initiated the program on the Web and received text messages, 34% had quit smoking at 6 weeks (28% with cotinine validation). These cessation rates are comparable or superior to the quit rates found for most minimal contact or self-help smoking-cessation interventions.21 Such comparisons, however, should be interpreted cautiously in view of the episodic and generally lower rates of smoking in college samples, compared with general adult samples, which may make it easier for college smokers to quit. In the absence of a control condition for this initial feasibility trial, conclusions regarding efficacy are premature. These quit rates, however, are promising and suggest that a behavioral smoking-cessation program can be delivered using text messaging to encourage college smokers to quit smoking cigarettes. College health personnel can provide this type of automated or computerized smoking-cessation program with minimal effort or resources.

Although we conducted no formal component analysis of this program, participants' self-reports indicated that the text messaging component was easier to use and more acceptable than the Web component was. Participants indicated that they used the text-messaging component (mean of 4.0 on a 5-point scale) more than the Web components (recording smoking rate of 2.0; viewing progress report of 1.8; reading educational modules of 1.7). Inadequate use of the Web site was also illustrated by the 37% of participants who failed to take the time to initiate the program. Although this poor initial use could reflect the transient nature of college smokers' motivation to quit, the qualitative responses of those who failed to initiate the program suggested that the lack of accessibility or convenience was a barrier to using the Web site. In contrast to text messages which, with the exception of SOS messages and replies, were "pushed out" to users, Web use required participants to seek out a computer with Internet access, to access the site, and to take the time required to interact with the site. The apparent preference for text messaging over Web delivery suggests that text messaging should be the predominant modality of treatment delivery for this program, and that predominantly Web-based programs may suffer from participants' inadequate regular program interactions.

Despite the preference for text messaging interventions, it remains unclear what aspects of text messaging were beneficial in supporting the quit attempts of these college smokers. Messages delivered on cell phones using SMS are limited to 160 characters; therefore, the content of these messages was short and consisted primarily of simple behavioral strategies or tips. The program was designed to send messages timed to likely high-risk situations, but it is unclear whether these messages were actually received in such situations or the timing of these messages improved their impact. Anecdotally, some participants reported that

<table>
<thead>
<tr>
<th>TABLE 3. Participants’ Mean Ratings of Program Questionnaire Items in a Study of a College Smoking-Cessation Text-Messaging Program</th>
</tr>
</thead>
<tbody>
<tr>
<td>Questionnaire items (agreement scored from 1 to 5)</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Quitters (n = 10)</td>
</tr>
<tr>
<td>M     %</td>
</tr>
<tr>
<td>---------------------------------------------------------------</td>
</tr>
<tr>
<td>Read text messages*</td>
</tr>
<tr>
<td>Successful in quitting smoking***</td>
</tr>
<tr>
<td>Successful in reducing smoking**</td>
</tr>
<tr>
<td>Successful in quitting or reducing smoking in this program in comparison with other quit attempts**</td>
</tr>
<tr>
<td>Satisfied with program**</td>
</tr>
<tr>
<td>Likely to recommend program**</td>
</tr>
<tr>
<td>Motivated to quit or remain nonsmoker**</td>
</tr>
<tr>
<td>Confident will quit and remain nonsmoker **</td>
</tr>
</tbody>
</table>

*p < .05. **p < .01. ***p < .001.
the text messages served as a “nagging” reminder of their quit date and their commitment to quit. If so, the content and timing of text messages may be less important than the participants’ simply committing to a quit date and being reminded about it regularly.

Two aspects of the text-messaging program were not used as much as we anticipated. First, participants seldom used the SOS or reply functions to request coping messages proactively or to interact with the program. Seventy-four percent of the participants reported that they never requested coping messages from the system. Certain cell phones and text messaging plans place barriers on outgoing messages by charging for such messages or providing phones without easy-to-use reply functions (ie, no reply function on text messages, requiring the user to type in the text message address to send a message). The lack of proactive text messaging, however, may also be consistent with the low degree of effort noted for the Web component. Subsequent program development should attempt to make these proactive requests and replies easier to perform.

Second, approximately one third (36%) of participants who initiated the program failed to specify a support person for their anti-smoking program. Those who used this feature indicated that their support people were only moderately supportive (M = 3.2 on a 5-point scale). A computerized program such as the one developed for this project cannot ensure the quality of support from those specified, but the ability of such a program to encourage social support from the smoker’s existing social support network would seem advantageous. Allowing supportive others to follow the progress of the smoker and send reminders to provide support at crucial times (eg, on quit day) is the strength of an automated communications system. Future program development should include more frequent contact and Web-based coaching of selected support people to improve the efficacy of this component.

Limitations

Participant Attrition

Of the 46 initial participants, we received full data for only 31 individuals (67% completion rate). We attempted to decrease participant attrition by requesting both school-year and summer-break contact information; however, we could not reach many of them at any of their contact numbers and addresses. Although this completion rate, particularly in a small sample, could have confounded the results, we found no significant differences in the pretest measures between participants who completed the study and those who dropped out. In addition, in computing quit rates, we used the conservative assumption that all who failed to complete the study also failed to quit smoking.

Delivery Modes

A potential limitation was the need for participants to have access to the Internet and to own a cell phone with text-messaging capabilities, although Internet and messaging represent 2 of the more frequently used modalities among the college-aged population. A recent report noted that 86% of college students are on the Internet, and these users use e-mails and instant messaging more heavily than do the general population.22 On a typical day, 26% of college students use text messaging. Of the approximately 90 million cellular phone users in the United States, two thirds (60 million) use digital phones; nearly all of them have SMS (System Management Software) or other text messaging functionality.22 Clearly, wireless digital cell phones and Internet access are becoming an increasingly ubiquitous part of many college students’ lifestyles. The cell phone requirement, therefore, is unlikely to place an insurmountable burden on potential participants.

Program Use

Of the 46 participants, 17 completed the baseline measures but did not initialize their treatment program on the Web. We conducted a separate telephone interview for these participants to determine the obstacles they faced in initializing their smoking program. Many indicated that they had intended to initialize their program but could not find the time or opportunity to do so. Almost all of them indicated that they would have initialized their program on the study Web site had they been able to do so at the time of signing up for the smoking program. These reports may reflect the transient nature of motivation to quit smoking among college smokers. Although fewer participants initiated the program than we had anticipated, we hypothesize that ambivalence about quitting and lack of convenient Internet access among this group of college students (50% of whom lived off-campus) may have influenced program participation.

Study Design and Evaluation Period

We did not include a control condition in this initial feasibility trial; therefore, it is not possible to determine whether the quit rates we found were significantly better than would have occurred from no treatment or a minimal self-help condition (eg, self-help book). In addition, the evaluation period for this study was only 6 weeks. Longer follow-ups are necessary to determine long-term abstinence rates from this program.

Future Work

On the basis of our findings from this trial study, we plan to improve on and enhance this wireless text-messaging smoking-cessation program for college students. We will evaluate the revised program in a multisite trial, comparing participants who receive the full smoking-cessation program with participants who follow a Web-only program. Potential modifications to the program include a more streamlined registration process and additional options and enhancements for individually tailoring the text-messaging component and improving social support contacts. These modifications should help overcome some of the difficulties faced in the prototype program and enhance the components that participants found most useful.
Text messaging using wireless cellular phones holds substantial promise as a treatment delivery method for a range of health-behavior interventions. Text messages can be delivered in real time and in the context of the targeted behaviors. Although we recognize content and interactivity limitations of text messages, these messages can be delivered daily at a high frequency without substantial disruption to the user. As a result, text-messaging systems can be used to promote health behaviors, provide coping strategies for various problems, or improve medication adherence. Future use of this method for research and development in the smoking-cessation area includes reminders of use of regular nicotine replacement tools and prompts for scheduled smoking-reduction programs.

Further research is needed to develop and evaluate smoking-cessation interventions that target college smokers, a growing group of smokers with unique motivations and smoking patterns. Innovative uses of technology should be further explored because such approaches are easy to disseminate and are potentially well-accepted by college students. It is important that smoking researchers, as well as college program administrators, continue to recognize the importance of addressing smoking among college students and create innovative cessation and prevention programs.

ACKNOWLEDGMENTS
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NOTE
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