Effectiveness of Short Message Service Text-Based Smoking Cessation Intervention Among University Students
A Randomized Clinical Trial

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IMPORTANCE Smoking is globally the most important preventable cause of ill health and death. Mobile telephone interventions and, in particular, short message service (SMS) text messaging, have the potential to overcome access barriers to traditional health services, not least among young people.

OBJECTIVE To determine the effectiveness of a text-based smoking cessation intervention among young people.

DESIGN, SETTING, AND PARTICIPANTS A single-blind, 2-arm, randomized clinical trial (Nicotine Exit [NEXit]) was conducted from October 23, 2014, to April 17, 2015; data analysis was performed from April 23, 2014, to May 22, 2015. Participants included daily or weekly smokers willing to set a quit date within 1 month of enrollment. The study used email to invite all college and university students throughout Sweden to participate.

INTERVENTIONS The NEXit core program is initiated with a 1- to 4-week motivational phase during which participants can choose to set a stop date. The intervention group then received 157 text messages based on components of effective smoking cessation interventions for 12 weeks. The control group received 1 text every 2 weeks thanking them for participating in the study, with delayed access to the intervention.

MAIN OUTCOMES AND MEASURES The primary outcomes were self-reported prolonged abstinence (not having smoked >5 cigarettes over the past 8 weeks) and 4-week point prevalence of complete smoking cessation shortly after the completion of the intervention (approximately 4 months after the quit date).

RESULTS A total of 1590 participants, mainly between 21 and 30 years of age, were randomized into the study; 827 (573 [69.3%] women) were allocated to the intervention group and 763 (522 [68.4%] women) were included in the control group. Primary outcome data were available for 783 (94.7%) of the intervention group and 719 (94.2%) of the control group. At baseline, participants were smoking a median (range) of 63 (1-238) and 70 (2-280) cigarettes per week, respectively. Eight-week prolonged abstinence was reported by 203 participants (25.9%) in the intervention group and 105 (14.6%) in the control group; 4-week point prevalence of complete cessation was reported by 161 (20.6%) and 102 (14.2%) participants, respectively, a mean (SD) of 3.9 (0.37) months after the quit date. The adjusted odds ratios (95% CIs) for these findings were 2.05 (1.57-2.67) and 1.56 (1.19-2.05), respectively.

CONCLUSIONS AND RELEVANCE With the limitation of assessing only the short-term effect of the intervention, the effects observed in this trial are comparable with those for traditional smoking cessation interventions. The simple NEXit intervention has the potential to improve the uptake of effective smoking cessation interventions.

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Smoking is responsible for more than 60 diseases and is globally the most important preventable cause of ill health and death. For every death related to smoking, more than 20 additional individuals will have at least 1 serious smoking-related illness.1

Tobacco is responsible for approximately 9.6% of the total disease burden in Sweden.2 Approximately 6000 people die every year in Sweden of diseases associated with smoking.1

Thousands of young people in Sweden start smoking each year. Tobacco use increases with age, and the earlier one starts smoking, the higher the risks of becoming addicted to nicotine and developing illnesses due to smoking.3 According to national surveys,4 the prevalence of daily smoking among young people between ages 16 and 29 years has been stable in the past 5 years in Sweden at approximately 11% to 13% among women and 7% to 10% among men. Most smokers start in their teens, and, over the course of a year, most young smokers want to quit or cut down.5,6 There is limited evidence on effective smoking cessation interventions among young people, and the younger population is less likely to seek treatment compared with older adults.2,7,8 Consequently, there is a need to increase interventions and develop attractive, effective programs that are capable of reaching underserved populations, such as young smokers.8,9 Apart from having the lowest smoking prevalence, Sweden is typical of other high-income countries in these respects.10

The rapid increase in the number of people owning a mobile telephone has led to new applications in self-management of chronic diseases and behavioral change interventions, particularly for SMS (short message service) text message-based services.9,11-13 Furthermore, mobile telephone interventions could overcome access barriers to traditional health services. Research on smoking cessation interventions using text messaging on mobile telephones is scarce and shows a mixed picture of effectiveness; most trials are pilot studies or are underpowered. A Cochrane review13 from 2012 included 5 trials with more than 9000 participants, and a significant long-term quit rate compared with a control program was seen (relative risk [RR], 1.71; 95% CI, 1.47-1.99). The review included a large trial that found a significant 6-month smoking cessation benefit of the intervention (RR, 2.20; 95% CI, 1.80-2.68). However, this trial and most others included all age groups. In addition, not all steps were automated, because eligibility and baseline data were collected by telephone. In a more recent review,1,4 a total of 13 studies were included in a meta-analysis of the efficacy of SMS text message-based smoking cessation interventions. The studies included in the meta-analysis were homogeneous, and odds ratios (ORs) suggested that text-based interventions generally increased quit rates compared with control interventions (OR, 1.35; 95% CI, 1.23-1.48). The meta-analysis also considered the content and structure of the interventions, and the pooled results indicated that more advanced technical interventions in addition to text messaging, including dynamic messaging that tracks pending answers to specific questions, tailoring messages to the individual participant, specific assessment messages requesting a response, and the provision of peer-to-peer support, did not significantly affect the effectiveness of text-based interventions.12 Therefore, an important research issue to be addressed is whether a simple, text-based smoking intervention, offering only one-way communication, is sufficient to accomplish smoking cessation. In this trial, we report on the effects of a simple SMS text message-based smoking cessation intervention targeting young adults in Sweden.

Methods

Study Design and Participants

Nicotine Exit (NEXit) was a single-blind, 2-arm, randomized clinical trial of an SMS text-based messaging smoking cessation intervention in which participants were randomized to an immediate-intervention or a delayed-intervention (control) group. The study was undertaken simultaneously in 25 student health care centers at all universities and colleges in Sweden except one university (Luleå University of Technology), which participated in a pilot study undertaken to refine trial procedures. Recruitment of participants was completed over a 3-week period (October 23 to November 13, 2014).14 The study was approved by the Regional Ethical Committee in Linköping, Sweden. The complete trial protocol is included in Supplement 1.

Eligible participants were students who were daily or weekly smokers and were willing to set a quit date for smoking cessation within the 4 weeks following enrollment.14 They indicated their interest by either responding to an email invitation or by sending an SMS text message to a dedicated telephone number, after which they received an email on how to register for the trial. Participants provided informed consent by clicking on a link in the email invitation; they were then referred to a baseline assessment page. The participants did not receive financial compensation. Follow-up was performed from March 6 to April 17, 2015.14

Invitations to participate were emailed over a 1-week period. Individuals consenting and randomized to the intervention could set a quit date 1 to 4 weeks after being exposed to preparatory content before the 12-week core program (see Interventions subsection below). Quit dates were thus set between 1 and 7 weeks after the initial invitation, and follow-up invitations were emailed 19 weeks after the initial recruitment email. The follow-up assessment was undertaken a mean (SD) of 3.9 (0.37) months after the quit date and thus assessed the short-term effect of the intervention. Because the study used a delayed-intervention (control) group design, ethical reasons limited the delay time.

Randomization and Blinding

After answering the baseline questionnaire and confirming their telephone numbers, participants were immediately randomized to the intervention group or the delayed-intervention group (Figure). Randomization was fully computerized and automated, used no blocks or strata, and allocated each participant a number 1 or 2 with equal probability using Java’s built-in random number generator (java.util.Random; https://docs.oracle.com/javase/7/docs/api/java/util/Random.html). Participants in both groups were aware
that they were participating in a trial and that they had been randomized to the intervention or control group. After the 4-month follow-up period, the control group received access to the intervention.

**Interventions**

We developed the messages in our intervention based on existing evidence-based practice, including components derived from expert guidance and official smoking cessation manuals recommended in Sweden (http://dok.slso.sll.se/CES/FHG/Tobak/Rapporter/srl-behandlingsupplrag-och-rutiner.2013_4.2014.pdf). We included key elements from previous text-based interventions and Internet-based interventions (http://www.viss.nu/Global/Bilagor/Tobaksavvanjning_0709.pdf).13,15-18 The intervention included elements such as making a public declaration about quitting (ie, telling friends about the quit attempt), asking friends and relatives for support, using problem-solving tips and distraction techniques, and the option to text for more help if craving to smoke or smoking (eMethods in Supplement 2).19

The NEXit core program lasts 12 weeks and is preceded by a 1- to 4-week motivational phase during which participants can choose to set a stop date. If the participants did not set a stop date within 4 weeks, they had agreed at the outset to try to stop at this time. The 12-week core program consists of 157 text messages, with the option to request extra messages when having cravings to smoke, relapse, or concerns about weight gain. The participants received 4 to 5 text messages per day in the first week, followed by a decreasing number of messages throughout the 12-week intervention.24 Both the intervention and control groups received text messages every 2 weeks thanking them for participating in the study.

**Outcomes**

The first primary outcome followed the Russell standard definition of prolonged abstinence since the quit date20 (restricting abstinence to the last 8 weeks of the 12-week intervention, thus allowing a grace period and applying the usual threshold of not smoking >5 cigarettes during the 8-week period). We calculated follow-up duration as the time since the quit date, departing from the Russell standard definition in the absence of biochemical verification since that approach was designed for studies with face-to-face contact. The timescales for follow-up were constrained by university term dates. The second primary outcome was 4-week point prevalence of not having smoked a single cigarette at the time of follow-up (ie, immediately after the intervention period). This time was chosen to capture delayed effects of the intervention as suggested by the Society for Research on Nicotine and Tobacco25 and used in previous studies.11,15,16,22,23

There were 4 secondary outcomes. These outcomes included (1) self-reported, 7-day point prevalence of smoking abstinence (defined as not smoking any cigarettes in the past 7 days)15,16,22,23; (2) mean number of quit attempts since taking part in the study15; (3) number of uses of other smoking cessation services (eg, prescribed medication including nicotine replacement, counseling, using telephone quitlines, or any other forms of professional help) since the first invitation to
the study; and (4) the number of cigarettes smoked weekly among participants still smoking at the time of follow-up.

For the 4-month follow-up, a link to an electronic follow-up questionnaire was emailed to all participants. Initially, 2 reminders were sent to nonresponders 1 week apart. To minimize attrition, nonresponders received additional email reminders every other day for 6 days (ie, 3 emails). If still not responding, these participants received a text message every other day for 6 days (ie, 3 texts) with only 2 questions capturing the 2 primary outcome measures. Those still not responding were telephoned a maximum of 10 times per participant, again assessing only the 2 primary outcomes. To aid in follow-up, participants were told that they would be entered into a lottery for 1 of 2 iPads (Apple Corp) after answering the follow-up questionnaire.

Sample Size
Based on previous studies, we expected an absolute difference of 5% in cessation rates between the intervention and control groups (with 10% quitting in the intervention group and 5% in the control group).

To achieve 80% power with a significance level of \( P \leq .05 \) (2-sided) and correction for continuity, a sample size of 474 participants is needed in each group. If there is 30% attrition in the follow-up measurement, the number needed in each group is 677 and the total required sample size is 1354. The allowance for attrition was deliberately conservative. All trial procedures were automated and implemented simultaneously for all participants (ie, intervention and control). A minority of university students in Sweden are smokers, and not all of the smokers are willing to participate in research. On the basis of a pilot study in one university not included in this study, we estimated the total number of invitations needed to recruit the required sample size. The sample size achieved was greater than required, indicating a slightly higher participation rate in the trial compared with the pilot study (0.9% vs 0.7%).

Statistical Analysis
The data analysis conformed to the prespecified statistical analysis plan as published in the trial protocol. Following the intention-to-treat analysis strategy, all primary analyses included only participants with follow-up data in their groups as randomized, thus assuming absent data to be missing at random (MAR). However, subsequent sensitivity analyses included all randomized participants to explore different assumptions about the missing data.

Continuous variables were summarized with descriptive statistics (number and mean [SD] for data with normal distribution or median [interquartile range] for nonnormally distributed data). Frequency counts and percentages of participants within each category were calculated for categorical data.

The binary outcomes of self-reported 8-week prolonged abstinence, 4-week point prevalence of complete smoking cessation, and 7-day point prevalence of smoking abstinence were analyzed by logistic regression, and the results are presented as ORs (95% CIs). The number of quit attempts and number of uses of other smoking cessation services were analyzed by negative binomial regression, and the results are presented as ratios of means (95% CIs). The number of cigarettes smoked weekly was analyzed by logarithmic transformation and linear regression, and the results are presented as the ratio of geometric means (95% CIs).

All regression analyses were adjusted for the following baseline variables: sex, years of smoking, mean number of cigarettes smoked weekly, severity of dependence as measured by the Fagerström Nicotine Dependence Scale, and amount of snus used at baseline. Effect modification analyses were performed for the 2 primary outcomes and the following potential effect modifiers that were measured at baseline: sex, mean number of cigarettes smoked weekly, amount of snus used weekly, and severity of dependence as measured by the Fagerström Nicotine Dependence Scale. Each effect modification analysis was performed by comparing adjusted logistic regression models excluding and including the interaction parameter using the likelihood ratio test. All tests were 2-sided with a 5% level of significance. A reviewer requested an additional, nonprespecified, effect modification analysis for frequency of smoking at baseline (daily vs weekly smoking); this analysis included the randomized group, the dichotomous measures of frequency of smoking at baseline and their interaction, and the adjustment variables listed above.

Sensitivity Analysis
A sensitivity analysis explored the effects of departures from the MAR assumption in the main analysis. As suggested by Jackson et al, we quantified departures from the MAR assumption by the informative missing OR (IMOR). We assumed that the IMOR was the same in each randomized group and we varied the IMOR over the range 0.5 to 1.0. If 10% of the observed data are on abstinence from cigarettes, this range implies that the abstinence factor is responsible for 5% to 10% of the missing data. We also set the IMOR to be 0 (missing = smoking, the Russell standard). Furthermore, we used data on the number of follow-up emails, texts, and telephone calls needed before an individual responded to explore the plausibility of the MAR assumption: first by exploring the association between quitting and the number of follow-up attempts needed, and then by fitting the repeated-attempts model of Jackson et al, which allowed us to estimate the degree of departure from MAR and to adjust for departure from MAR. Data analysis was performed from April 27 to May 22, 2015; SPSS, version 23 (IBM Corp) and Stata, version 13 (StataCorp) were used to conduct the analyses.

Results
A total of 1590 participants were randomly assigned: 827 (52.0%) to the NEXit intervention group (573 [69.3%] women) and 763 (48.0%) to the control group (522 [68.4%] women) (Figure). A summary of the participants’ characteristics at baseline is given in Table 1. There were no significant differences in any of the sociodemographic characteristics or smoking variables.
Outcome Analyses
The primary outcome analysis was done on a total of 783 (94.7%) randomized participants in the intervention group and 719 (94.2%) in the control group. The number of participants who achieved 8 weeks of prolonged abstinence at the 4-month follow-up (having smoked ≤5 cigarettes during this time) was 203 (25.9%) in the intervention group and 105 (14.6%) in the control group (adjusted OR, 2.05; 95% CI, 1.57-2.67). The 4-week point prevalence of complete smoking cessation occurred in 161 (20.6%) vs 102 (14.2%) participants (adjusted OR, 1.56; 95% CI, 1.19-2.05) (Table 2). No evidence of effect modification was shown for either primary outcome (P values between 0.13 and 0.58).

Secondary outcome data were available only for participants completing the follow-up questionnaire by email, and included 557 (67.4%) of the participants in the intervention group and 429 (56.2%) in the control group (χ² = 20.86; P < .001). There were 377 (67.7%) smokers remaining in the intervention group and 429 (56.2%) in the control group (χ² = 20.86; P < .001). Thirteen cigarettes were smoked per week in the intervention group, compared with 17 in the control group (P = .01). The repeated-attempts model suggested that the intervention was effective in reducing cigarette consumption, increasing the number needed to treat to 16.

Sensitivity Analyses
Sensitivity analyses explored the effects of departures from the MAR assumption on the primary outcomes. Varying the IMOR, or using missing = smoking, changed the estimated ORs by less than 0.01. The repeated-attempts model suggested that the IMOR was 0.3 to 0.6 in the control arm and 0.7 to 1.4 in the intervention arm and gave ORs (95% CIs) of 1.82 (1.39-2.38) for 8 weeks of prolonged abstinence and 1.44 (0.90-1.91) for 4-week point prevalence of complete smoking cessation. Further details are provided in the eTable in Supplement 2.

Post Hoc Analyses
There was no evidence of effect modification of frequency of smoking at baseline (daily vs weekly smoking) on self-reported abstinence (P = .79) or on self-reported, 4-week point prevalence of complete smoking cessation (P = .48). A total of 257 (31.1%) of the participants in the intervention group requested extra messages. Of these, 128 (49.8%) requested 1 extra message; the remainder were made use of function a mean (SD) of 3.4 (2.1) times (range, 2-13 times). Only 1 of the 6 outcomes (number of quit attempts) had a statistically significant difference between those who requested extra messages and those who did not request extra messages (mean [SD] quit attempts, 2.81 [2.87] vs 2.14 [2.29]; P = .01).

Discussion
The NEXit text-message intervention approximately doubled the rate of prolonged abstinence (allowing occasional lapses) at the 4-month follow-up, with a risk difference of 11.3% (number needed to treat, 9). The risk difference was somewhat smaller (6.4%) for the 4-week point prevalence of complete smoking cessation, increasing the number needed to treat to 16.

Sensitivity analyses allowing for different IMOR values for the 2 primary outcomes showed similar results, which remained statistically significant, thus providing strong support for an intervention effect. The intervention group also did better than the control group on all secondary outcomes in the main analyses, with an RR difference of 16.4% and number needed to treat of 6 for the 7-day complete smoking cessation outcome. Accounting for multiplicity of outcomes by applying a Bonferroni correction to the primary outcomes alone, to the secondary outcomes alone, or even to the combined sets made no difference to the study findings, all of which remained statistically significant.

A major strength of this study is the low rate of attrition for the primary outcomes. Large numbers of individuals were randomized using a fully automated system that cannot be subverted and does not involve initial personal contact, as used in previous studies. Limitations of the study include the

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**Table 1. Baseline Characteristics of the Participants in the Intervention and Control Groups**

<table>
<thead>
<tr>
<th>Variables</th>
<th>Intervention (n = 827)</th>
<th>Control (n = 763)</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. (%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female sex</td>
<td>573 (69.3)</td>
<td>522 (68.4)</td>
</tr>
<tr>
<td>Age, y</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;21</td>
<td>70 (8.5)</td>
<td>74 (9.7)</td>
</tr>
<tr>
<td>21-25</td>
<td>372 (45.0)</td>
<td>326 (42.7)</td>
</tr>
<tr>
<td>26-30</td>
<td>181 (21.9)</td>
<td>176 (23.1)</td>
</tr>
<tr>
<td>≥31</td>
<td>204 (24.7)</td>
<td>187 (24.5)</td>
</tr>
<tr>
<td>Unmarried</td>
<td>524 (63.4)</td>
<td>459 (60.2)</td>
</tr>
<tr>
<td>Duration of smoking, median (IQR), y</td>
<td></td>
<td></td>
</tr>
<tr>
<td>803 Participants</td>
<td>8 (5-13)</td>
<td>8 (5-13)</td>
</tr>
<tr>
<td>Geometric mean (SD)y</td>
<td></td>
<td></td>
</tr>
<tr>
<td>48.13 (43.32)</td>
<td>48.40 (44.79)</td>
<td></td>
</tr>
<tr>
<td>Median (range)</td>
<td>63 (1-238)</td>
<td>70 (2-280)</td>
</tr>
<tr>
<td>Using snus</td>
<td>194 (23.5)</td>
<td>169 (22.1)</td>
</tr>
<tr>
<td>Fagerström Nicotine Dependence Scale*</td>
<td>803 Participants</td>
<td>746 Participants</td>
</tr>
<tr>
<td>Score 0–10, median (IQR)</td>
<td>3 (1–5)</td>
<td>3 (1–5)</td>
</tr>
<tr>
<td>Nondependent (0–1)</td>
<td>182 (22.7)</td>
<td>171 (22.9)</td>
</tr>
<tr>
<td>Low dependence (1–2)</td>
<td>205 (25.5)</td>
<td>168 (22.5)</td>
</tr>
<tr>
<td>Moderately dependent (3–5)</td>
<td>277 (34.5)</td>
<td>278 (37.3)</td>
</tr>
<tr>
<td>Highly dependent (6–8)</td>
<td>135 (16.8)</td>
<td>126 (16.9)</td>
</tr>
<tr>
<td>Very highly dependent (9–10)</td>
<td>4 (0.5)</td>
<td>3 (0.4)</td>
</tr>
<tr>
<td>Importance of quitting, median (IQR)*</td>
<td>9 (7–10)</td>
<td>9 (8–10)</td>
</tr>
<tr>
<td>Quit attempts, median (IQR)</td>
<td>3 (1–4)</td>
<td>3 (1–5)</td>
</tr>
<tr>
<td>Previous use of nicotine replacement therapies, median (IQR)</td>
<td>0 (0–2)</td>
<td>0 (0–2)</td>
</tr>
<tr>
<td>Previously use of prescribed cessation drugs</td>
<td>45 (5.4)</td>
<td>52 (6.8)</td>
</tr>
<tr>
<td>Previous cessation counseling experience</td>
<td>40 (4.8)</td>
<td>48 (6.3)</td>
</tr>
<tr>
<td>Current cessation counseling</td>
<td>6 (0.7)</td>
<td>7 (0.9)</td>
</tr>
<tr>
<td>Previous contact with national telephone quitting</td>
<td>35 (4.2)</td>
<td>31 (4.1)</td>
</tr>
</tbody>
</table>


* A total of 1549 participants were included in the analysis of this variable (41 participants did not state how many cigarettes they smoked). For other variables, percentages were based on the sample sizes in the column headings.

**Approximate SD back calculated from the log scale.

Assessed on a scale of 1 (not important) to 10 (very important).
The nationwide proactive recruitment approach used in the present study. These second study16 report a risk difference of 15.3% for not smoking in the last 7 days, after 6 weeks of follow-up.

In a recent meta-analytic review13 of the effectiveness of SMS text-message interventions for smoking cessation, 13 studies yielded an OR (95% CI) of 1.35 (1.23-1.48) for not smoking in the past 7 days at the time of follow-up in the intervention group, with no heterogeneity. This finding compares with an unadjusted OR of 2.53 (1.85-3.47) for our equivalent secondary outcome measure, which is subject to attrition, and with an adjusted OR of 1.56 (1.19-2.05) for the more stringent short-term (4-week) primary outcome unlikely to be affected by attrition.

Considering that we assessed only the short-term effect of the intervention, the ORs for prolonged abstinence, 7-day, and 4-week point prevalence cessation outcomes are comparable to those of traditional smoking cessation interventions. With findings reported as RR (95% CI), these interventions include telephone quitlines (1.37 [1.26-1.50]),28 group behavior counseling (1.98 [1.60-2.46]),29 and individual behavior counseling (1.39 [1.24-1.57]).30

The nationwide proactive recruitment approach used in our study reached young adults who had low rates of use of

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**Table 2. Primary and Secondary Outcomes**

<table>
<thead>
<tr>
<th>Variables</th>
<th>No. (%)</th>
<th>Intervention (n = 827)</th>
<th>Control (n = 763)</th>
<th>Intervention vs Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary outcomes</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Self-reported prolonged abstinence</td>
<td>1502</td>
<td>783 (94.7)</td>
<td>719 (94.2)</td>
<td>2.05 (1.58-2.66)</td>
</tr>
<tr>
<td>Self-reported 4-wk prevalence of complete smoking cessation</td>
<td>1502</td>
<td>161 (20.6)</td>
<td>102 (14.2)</td>
<td>1.57 (1.19-2.05)</td>
</tr>
<tr>
<td>Secondary outcomes</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Self-reported, 7-d point prevalence of smoking abstinence</td>
<td>986</td>
<td>180 (32.3)</td>
<td>68 (15.9)</td>
<td>2.53 (1.85-3.47)</td>
</tr>
<tr>
<td>No. of uses of other smoking cessation services</td>
<td>986</td>
<td>0.24 (0.49)</td>
<td>0.16 (0.41)</td>
<td>1.52 (1.14-2.03)</td>
</tr>
<tr>
<td>Secondary outcome in those still smoking</td>
<td>738</td>
<td>377 (67.7)</td>
<td>361 (84.1)</td>
<td></td>
</tr>
<tr>
<td>No. of quit attempts</td>
<td>738</td>
<td>2.40 (2.88)</td>
<td>1.62 (2.07)</td>
<td>1.49 (1.24-1.78)</td>
</tr>
<tr>
<td>No. of cigarettes smoked weekly by participants still smoking</td>
<td>659</td>
<td>15.44 (26.99)</td>
<td>36.65 (45.18)</td>
<td>0.42 (0.33-0.53)</td>
</tr>
</tbody>
</table>

* Adjusted for sex, years of smoking, number of cigarettes smoked weekly, severity of dependence as measured by the Fagerström Nicotine Dependence Scale (categories described in Table 1), and amount of snus used at baseline.
* Odds ratio (95% CI) determined with logistic regression.
* Ratio of means (95% CIs) determined with negative binomial regression.
* Includes prescribed medication, nicotine replacement medication, group or individual professional help, or calling telephone quitline since first invitation to the study.

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Despite these differences, our study showed no attenuation in risk difference compared with 2 larger studies35,36 of 6-month intervention that included more technically advanced features, such as personalized messages and peer-to-peer support. The first study15 reported risk differences for not smoking during the last 7 days of 5.9% and during the last 4 weeks of 6.3% compared with 16.9% and 6.4%, respectively, observed in the present study. The second study16 reported a risk difference of 15.3% for not smoking in the last 7 days, after 6 weeks of follow-up.
any forms of smoking cessation support before participating in this trial. The previous number of quit attempts was low, with a median of 3 previous attempts during a median duration of smoking of 8 years. Our results thus add to the growing body of evidence for the reach and effectiveness of text-based smoking cessation interventions. The quit rates compare well with those of traditional smoking cessation interventions and cost less to enlarge; therefore, they should be highly cost-effective. The technical simplicity of the NEXIT intervention also indicates that there might not be any need to complicate the structure of text-based interventions with sophisticated pathways that may not provide added benefit and would also increase the cost of developing and delivering such interventions. However, one important remaining issue to demonstrate is the reach of text-based interventions when offered to whole populations, since this study recruited participants to a research study rather than a direct offer of intervention.

Text-messaging interventions could also be used in combination with initial face-to-face contacts within health care settings or via telephone quitlines, facilitating smokers to register for text-based interventions. This combination could change the way staff interact with and use new technology, saving time and potentially increasing the effectiveness of health behavior interventions endeavors to have an impact at a population level. In addition, analysis of a previous text-based message intervention clearly showed that it was cost-effective. Although undertaken in a high-income country, this study is relevant for low- and middle-income countries where approximately 80% of the more than 1 billion smokers worldwide now live and where interventions such as the one evaluated here can be delivered beyond health care settings.

Conclusions

The present study shows that it is possible to use a proactive recruitment strategy to enroll a large number of young adults in a research study. The effectiveness of this fairly low-technology intervention was comparable with previous, more sophisticated, tailored text-messaging interventions as well as traditional face-to-face smoking cessation interventions. The results are promising not only for smoking cessation but also for other areas of disease management and health interventions because, by using a relatively simple technology, the development costs can be low and sophisticated monitoring of technical aspects is not required.

REFERENCES
Editor's Note

Texting for Health Education

Mitchell Katz, MD

When I want my 13-year-old son to do something, I do not go to his room (“Get away, Dad!”) or email him (so yesterday!) or call him (he will not answer). Instead, I text him. His usual answer is “k,” but it gets the job done. Therefore, I was not surprised that texting young adults was an effective smoking cessation technique. Specifically, in this issue of JAMA Internal Medicine, Müssener et al report that 8-week prolonged abstinence was almost twice as high among those randomized to receive specially tailored smoking cessation texts compared with those in the control group (25.9% vs 14.6%).

Of course, this is just one study and, unfortunately, biochemical confirmation of tobacco cessation was not possible. Still, if we are to make progress in health education, our techniques must keep up with how people wish to receive their information. Smart phones are almost ubiquitous, even among relatively low-income populations, and interventions using texts are likely to be much less costly than interventions involving face-to-face interactions. We need to figure out how to harness the power of smart phones—and not just for getting our children to throw out the garbage.

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