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Mobile Text Messaging Interventions for Smoking Cessation: A Systematic Review

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Background: Smoking is one of the most serious health problems worldwide. The aim of this systematic review was to demonstrate the effect of text messaging-based interventions on smoking cessation.

Methods: Electronic databases were searched using specific key terms. The inclusion criteria were (1) articles that employed a randomized controlled trial and (2) articles that examined the effect of text messaging interventions on smoking cessation. However, studies employing multimedia messaging service and smartphone apps were excluded.

Results: In total, six randomized controlled trial studies with seven interventions were included in this systematic review. Of these six studies, almost all concluded that text-messaging interventions had no significant effect on smoking cessation. However, one study conducted in England revealed that text messaging intervention groups had a higher rate of six-month prolonged abstinence from smoking than did the control group.

Conclusion: Text messaging interventions could be effective for those who want to quit smoking. We aimed to determine the effectiveness of using text messaging interventions for smoking cessation. However, there were only six studies that employed randomized controlled trials to determine such effectiveness. More studies on the effect of text messaging interventions for smoking cessation using subjects from various age groups and socioeconomic backgrounds are needed in the future.

Keywords: Smoking Cessation; Text Messaging; Short Message Service

INTRODUCTION

According to the 2013 World Health Organization (WHO) report, 21% of global adults were current smokers, which included 950 million men and 177 million women. Compared to the 2007 WHO report, smoking prevalence has declined worldwide. However, there are still 1.1 billion smokers globally.¹⁾ A previous cohort study revealed an increase in all health-related causes of death among smokers. Smoking increases the risk of death from lung cancer, chronic obstructive pulmonary disease, ischemic heart disease, and any type of stroke.²⁾ Moreover, cigarette

smoking causes more than 480,000 deaths in the United States every year according to the 2014 Surgeon General's report.³⁾ The mortality and morbidity of diseases related to tobacco use could be reduced by quitting cigarette smoking. Many studies have proved that smoking cessation interventions including medications, consultations, and behavioral support are effective in stopping smoking.⁴⁾

Mobile phones are utilized worldwide. The number of mobile phone users was estimated to be 4.55 billion globally, including 1.75 billion smartphone users in 2014.⁵⁾ Mobile phone users can share text messages and make calls; they also have wireless internet services. Thus, several

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studies on various topics have investigated the effect of mobile technology-based treatment, especially focusing on text messaging intervention. For instance, the effectiveness of text messaging interventions on weight loss,⁶⁾ medication adherence of asthma or human immunodeficiency virus patients,^{7,8)} and diabetes patients' glycemic control^{9,10)} has been proven in previous randomized controlled trials. Smoking cessation is another one of such topics.¹¹⁾ Recently, Scott-Sheldon et al.¹²⁾ conducted a systematic review and meta-analysis on the effect of text messaging-based interventions on smoking cessation. However, they also included video messaging-based interventions and smart phone applications.¹²⁾

Thus, the aim of this systematic review was to determine the effect of only text messaging-based interventions on smoking cessation. Because text messaging can be used by all mobile phone users, interventions using text messaging may be more feasible (for various age groups ranging from adolescents to senior people) than using smartphone apps, a learning management system (LMS), or a multimedia messaging service (MMS).

METHODS

Studies that investigated the effect of text messaging intervention on smoking cessation and estimated smoking cessation outcomes in randomized controlled trials published as electronic publications or dissertations until May 31, 2016 were included in this study. The following studies were excluded: (1) those that used text messaging interventions to help people who had already quit smoking,¹³⁾ (2) those that investigated not only text messaging, but also other interventions, such as pamphlet- and booklet-based interventions, (3) those that supplemented text messaging interventions, including LMS and smartphone apps. However, studies on phone counseling interventions were not excluded because they were applied during outpatient interviews or cognitive behavioral therapy. This systemic review was conducted following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) checklist (Figure 1).¹⁴⁾

1. Information sources and search strategy

The following electronic databases were searched: PubMed (n=655),

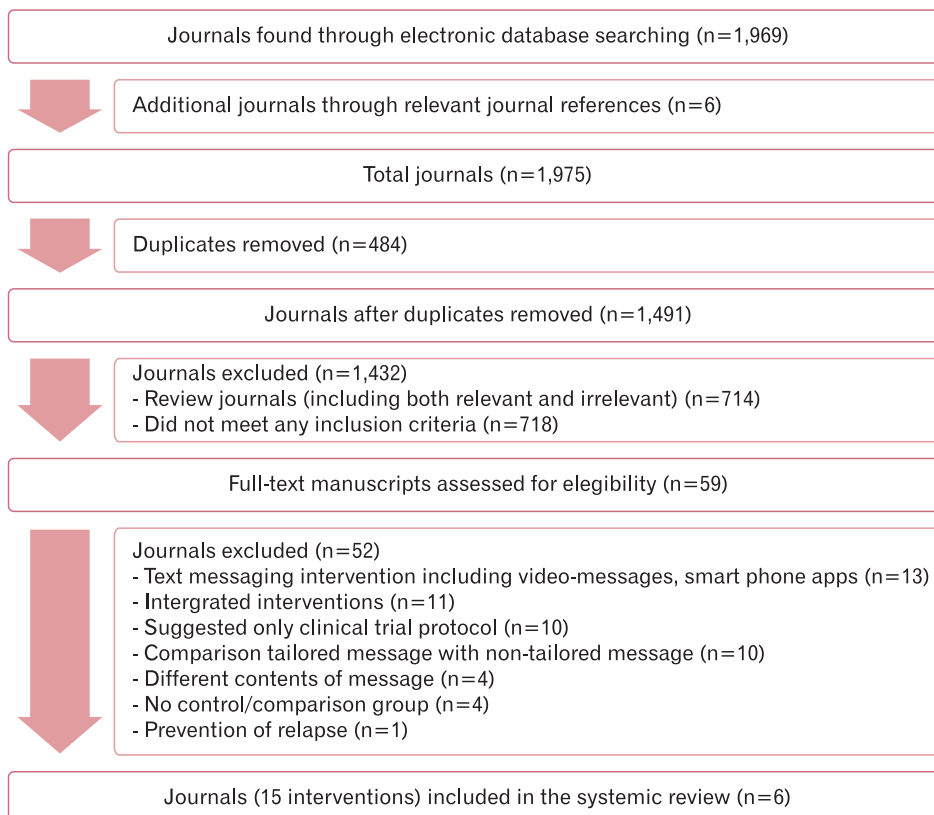


Figure 1. Study retrieval and selection.

Cochrane Library (n=401), and Embase (n=913). Searches were conducted repeatedly and independently between June 31 and August 31, 2016, by two authors with the purpose of including all publications that matched our eligibility criteria. In addition, all references related to previous systematic reviews and meta-analyses of text messaging interventions for smoking cessation were searched. Search terms were set for the two major themes: tobacco ("tobacco," and "smoke") and types of cessation interventions ("text message," "cellular phones," "phone," "mobile," "mobile devices," "short message service," and "SMS"). Within each theme, the Boolean search term "OR" was used to combine terms and "AND" was then used to find instances of intersections between the searched terms. We applied language restrictions and selected only those articles that were written in English. Our initial searching restriction was on titles and abstracts.

2. Study selection and quality assessment

First, we screened titles and abstracts that matched our inclusion criteria. Next, we reviewed the full texts of papers to determine whether they met our exclusion criteria. Following this, papers that fulfilled our inclusion criteria without meeting our exclusion criteria were included in this study.

Two independent coders then extracted the following characteristic information from each study: paper's information (i.e., year of publication and data collection), demographic information (i.e., race, gender), and intervention procedures (i.e., frequency of sending text message).

Full papers that fulfilled our inclusion criteria were assessed for quality according to the National Institutes for Health (NIH) quality assessment guidelines.¹⁵⁾ Disagreements between the two coders were resolved by discussions following which they arrived at a consensus.

3. Study outcomes

Several randomized controlled trial studies were reviewed to evaluate the effectiveness of text-messaging intervention on smoking abstinence. Individuals who received text-messaging interventions were assigned to the intervention group, while those who did not receive any text-messaging intervention were assigned to the control group.

The study outcomes for smoking cessation were assessed. Measurements of smoking cessation included the prevalence of smoking abstinence and continuous abstinence from the quit date.

RESULTS

A total of 1,969 papers were extracted from electronic databases following the search strategies. Another six papers were extracted after reviewing the references of previous systematic review studies. Duplicate papers and those that did not meet our inclusion criteria at this stage were excluded. Finally, a total of 59 manuscripts were obtained. After reviewing their full texts and excluding studies that did not meet our inclusion criteria—for example, those with randomized controlled trials that compared not only text messaging but also other multimedia interventions, such as smart phone apps or those that compared integrated interventions including both text messaging interventions and pamphlets—a total of six studies reporting seven interventions were finally included for this systematic review (Figure 1).¹⁶⁻²¹⁾

Information was extracted from these six studies with seven interventions; the details are summarized in Table 1.¹⁶⁻²¹⁾ The median year of publication was 2013 (range: 2009–2016), but the data collection years varied. The study by Shi et al.¹⁹⁾ did not state the data collection year. Studies also varied in sample size, ranging from 174 to 42,717. Approximately 50% of the subjects were female. However, in one study,¹⁹⁾ the number of female subjects was extremely low. Most studies targeted adolescents or young adults. The mean age of subjects in these studies ranged from 25 to 48.33 years. Among these six studies, three were conducted in Europe (i.e., Germany, Switzerland, and England), while the other three were conducted in the United States, Turkey, and China. The study duration ranged from 12 weeks to 6 months. The duration of interventions ranged from 3 months (90 days or 12 weeks) to 56 weeks. One study by Haug et al.¹⁷⁾ recruited participants through an online screening, while the other five studies recruited participants offline.

In all studies, the intervention group received only text messages. However, other interventions were added in two studies.^{18,19)} The frequency of sending text messages varied from less than once a week to daily, at most. The total number of text messages ranged from 14 to 217. In most studies, a two-way text messaging intervention was used. However, in the study by Ybarra et al.,²⁰⁾ a one-way text messaging intervention was used.

The length of the follow-up period ranged from three to six months. Outcomes had variable measures, including self-reported point prevalence abstinence status, seven-day point prevalence, and change in quitting stage.

Table 1. The study, sample, and intervention characteristics of the six selected articles

	Sample	Location/ participants	Recruitment method	Control	Intervention/ duration	Delivery	Frequency	Communication- on flow	Outcomes	F/U
Haug et al. ¹⁶⁾	n=174; 56.9% F(99/174); 25 y	Germany/ university		Assessment only control	SMS/3 mo	Text	Low	Two-way text messaging	Quit attempt, cigarettes per day	3 m
Haug et al. ¹⁶⁾	n=174; 56.9% F(99/174); 25 y	Germany/ university		Assessment only control	SMS/3 mo	Text	High	Two-way text messaging	Quit attempt, cigarettes per day	3 m
Haug et al. ¹⁷⁾	n=755; 51.9% F(392/755); 18.2 y	Switzerland/ adolescents	Online screening	Assessment only control	SMS/6 mo	Text	High	Two-way text messaging	7-d point prevalence smoking abstinence, 4-wk point prevalence smoking abstinence, cigarettes per day	6 m
Naughton et al. ¹⁸⁾	n=602; 52.7% F(317/602); 41.8 y	England/clinics	Local GP surgery	Relevant content, not time-matched	iQuit/3 mo	Text, CBT, reports	Varied	Two-way text messaging	Self-reported 2-wk point prevalence abstinence at 8-wk follow-up	2 m, 6 m
Shi et al. ¹⁹⁾	n=179; 95.5% M(171/179); 17 y	Shanghai, China/ adolescents	With the help of health teachers	Relevant content, not time-matched	Not reported/ 3 mo	Text, pamphlet, communication	High	Two-way text messaging	Change in quitting stage, self- reported 7-d abstinence, 30-d abstinence	3 m
Ybarra et al. ²⁰⁾	n=151; 39% F; 36 y	Ankara, Turkey/ adults	Shopping malls & advertisements	Relevant content, not time-matched	SMS/3 mo	Text	Varied	One-way text messaging	7-d point prevalence, 30-d point prevalence, continuous abstinence, cigarettes per d/wk	3 m
Boal et al. ²¹⁾	n=42,717; 51.9% F:40,84 y	United States	Phone call	Relevant content, not time-matched	Text/6 mo	Text	Varied	Two-way text messaging	Self-reported 7-d abstinence at 6 mo	6 m

F/U, follow-up; F, female; M, male; GP, general practitioner; SMS, short message service; CBT, cognitive behavior therapy.

These six studies came to different conclusions about the effect of using text messaging interventions on smoking cessation. The studies by Haug et al.¹⁶⁾ and Ybarra et al.²⁰⁾ showed no significant differences in the abstinence rate between the control group and the intervention group. Boal et al.²¹⁾ reported similar rates of seven-day abstinence in both groups. Haug et al.¹⁷⁾ reported that the decrease in the mean number of cigarettes smoked per day was higher in the intervention group. However, attempts to quit and the stage of change were not significantly different between the two groups. Naughton et al.¹⁸⁾ reported that there was no significant difference in the self-reported two-week point prevalence abstinence at the eight-week follow up or in the smoking outcome four weeks after the quit date. However, a six-month prolonged abstinence was higher in the intervention group than in the control group. Shi et al.¹⁹⁾ reported that the intervention group had relatively higher rates of self-reported 7- and 30-day abstinence. However, the differences were not statistically significant. In contrast, smoking reduction and moving forward in the quitting stages had significantly higher rates in the intervention group than in the control group.

The two independent authors of this study reviewed and discussed the six extracted studies based on the NIH quality assessment guidelines using 12 items (Table 2).¹⁶⁻²¹⁾ Sample size justification was not determined for the study by Haug et al.¹⁶⁾.

DISCUSSION

The aim of this study was to evaluate the effectiveness of text messaging interventions for smoking cessation. Several previous systematic reviews and meta-analytic studies have shown that mobile text messaging interventions are effective for smoking cessation.^{12,22,23)} However, our study showed that the text-messaging intervention had no significant influence on smoking cessation. There are many possible causes for such a difference in results. First, MMS and smartphone apps were included in previous studies. However, only mobile text messaging interventions were included in this study. Short message service (SMS) interventions were the easiest and the most accessible means to target subjects of all ages, including older people who did not use smartphones. For this reason, we limited the interventions to only text messaging. Second, the randomized controlled trials included in our study only investigated the effect of text messaging intervention. However, previous systematic reviews and meta-analytic studies included many publications that investigated

Table 2. Quality assessment of 6 journals

Journals	Quality assessment criteria									
	Stated objective	Population	Sample size justification	Control selected from similar population	Consistently implementation	Differentiated cases from controls	Randomization	Con-current controls	Prior exposure/risk	Implemented consistently exposure/risk
Haug et al. ¹⁵⁾	Y	Y	CD	Y	Y	Y	Y	Y	Y	Y
Haug et al. ¹⁶⁾	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Naughton et al. ¹⁸⁾	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Shi et al. ¹⁹⁾	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Ybarra et al. ²⁰⁾	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Boal et al. ²¹⁾	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

Y, yes; CD, cannot determined; N, no.

text messaging interventions as well as web-based or pamphlet interventions.” Therefore, although previous studies revealed the effectiveness of mobile text messaging interventions on smoking cessation, they also included interventions other than text messaging.

We reviewed a total of six studies with seven interventions that included a total of 7,423 subjects. The findings from these six studies showed that text messaging interventions had no significant effect on smoking cessation over a short period. However, such interventions may be effective over a long period, although the effectiveness might not be statistically significant.

The strength of this study was that it investigated only SMS interventions, assumed to be the most convenient way to support everyone who wants to quit smoking, including the elderly and those with a low socioeconomic status. Smoking is one of the most important health problems in the world. It causes many disorders that can lead to death. Smoking cessation can thus lower the prevalence of several disorders. In the 2014 WHO report, the tobacco smoking prevalence among adults was 21% globally, 25% in high-income countries, 21% in middle-income countries, and 16% in low-income countries.¹⁾ According to this data, high-income countries have the highest prevalence of smoking. However, monitoring the proportion of smokers in each country is needed before interpreting such data. Although the proportions of smokers in high-income countries were higher than those in other countries, there were no data for 13 low-income countries. Therefore, the prevalence of smoking may be higher than reported in low-income countries. Although cognitive behavioral therapy might be effective for smoking cessation, it is uncomfortable for someone who does not like to receive medical support. In addition, medical treatment might be more effective when it is combined with counseling by a physician and cognitive behavioral therapy. An SMS intervention is the most convenient way to support smoking cessation. The only condition for anyone who wants to participate in this intervention is that they use cell phones. There is no reason to have a smartphone or access to the Internet. They just need to be able to read SMS texts. Therefore, everyone (from low-income individuals to high-income individuals, from the young to the elderly) can benefit from this intervention. In addition, SMS texts are inexpensive compared to MMS, LMS, or voice messages.

When interpreting this systematic review, a few limitations should be considered. First, among the six publications included, all of them utilized tailored text messaging intervention—a system that sends messages

according to an individual's status—which might be more effective than non-tailored text messaging. Several previous randomized controlled trials have investigated the effectiveness of tailored text messaging compared to non-tailored text messaging.²⁴⁻²⁸⁾ First, the results of three studies revealed that tailored text-messaging was significantly more effective than non-tailored messaging. However, Skov-Ettrup et al.²⁷⁾ reported no significant difference in effectiveness between the two groups. Free et al.²⁵⁾ also revealed that tailored text-messaging had no significant effect on smoking cessation at six months, although it showed an improved effect at four weeks.

Second, the six publications reviewed in this study employed bidirectional text messaging interventions, which can not only identify reactions of participants, but also help participants who have problems in smoking cessation. Bidirectional text messaging is also used to offer participants immediate help, such as if a user need any demand, then user send text message include on-demand keyword "CRAVE".²¹⁾ However, other studies helped participants in different ways, such as by providing counseling by phone or in a medical office. Therefore, bidirectional text messaging intervention might not be as effective as other intervention methods for smoking cessation.

Third, the six publications included in our systematic review had different outcome measurements. Previous investigations about variable measurements of smoking abstinence recommended different ways to measure it. Since none is superior to the others, clinical investigators selected a measurement that was suitable for each trial.²⁹⁾ Therefore, we could not compare the measurements for each other. The measurements of smoking cessation used in the six randomized controlled trials included in this study were subjective, not objective, tools. Therefore, further studies are needed to determine the best measurement tool for smoking cessation.

In conclusion, text messaging intervention is the most convenient intervention for anyone who wants to quit smoking anywhere in the world. Therefore, several previous studies have aimed to determine the effectiveness of text messaging intervention for smoking cessation. Previous systematic reviews and meta-analyses have shown that text messaging intervention might be effective for people who want to quit smoking. However, they included other interventions such as cognitive behavior therapy and pamphlets. In addition, they not only included SMS interventions, but also smartphone apps and MMS. Therefore, in this study, we restricted the interventions to SMS-only interventions, which can be

received by people with low or high income and of different ages (from adolescents to the elderly). After investigating whether SMS interventions were effective for smoking cessation by reviewing previous publications, our results revealed that only SMS interventions had no significant effect on smoking cessation. However, just six publications that studied the effect of SMS-only interventions on smoking cessation were included in our systematic review. Therefore, more studies are needed to investigate the effect of SMS-only interventions on smoking cessation. In addition, more studies are needed to determine the standard messaging strategy.

CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

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