



Review Article

Participant-level meta-analysis of mobile phone-based interventions for smoking cessation across different countries

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ABSTRACT

With meta-analysis, participant-level data from five text messaging-based smoking cessation intervention studies were pooled to investigate cessation patterns across studies and participants. Individual participant data ($N = 8315$) collected in New Zealand (2001–2003; $n = 1705$), U.K. (2008–2009; $n = 5792$), U.S. (2012; $n = 503$; $n = 164$) and Turkey (2012; $n = 151$) were collectively analyzed in 2014. The primary outcome was self-reported 7-day continuous abstinence at 4 weeks post-quit day. Secondary outcomes were: (1) self-reported 7-day continuous abstinence at 3 months and (2) self-reported continuous abstinence at 6 months post-quit day. Generalized linear mixed models were fit to estimate the overall treatment effect, while accounting for clustering within individual studies. Estimates were adjusted for age, sex, socioeconomic status, previous quit attempts, and baseline Fagerstrom score. Analyses were intention to treat. Participants lost to follow-up were treated as smokers. Twenty-nine percent of intervention participants and 12% of control participants quit smoking at 4 weeks (adjusted odds ratio [aOR] = 2.89, 95% CI [2.57, 3.26], $p < .0001$). An attenuated but significant effect for cessation for those in the intervention versus control groups was observed at 3 months (aOR = 1.88, 95% CI [1.53, 2.31]) and 6 months (aOR = 2.24, 95% CI [1.90, 2.64]). Subgroup analyses were conducted but few significant findings were noted. Text messaging-based smoking cessation programs increase self-reported quitting rates across a diversity of countries and cultures. Efforts to expand these low-cost and scalable programs, along with ongoing evaluation, appear warranted.

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Abbreviations: SMS, Stop My Smoking; SES, socioeconomic status; aRR, adjusted relative risk.

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1. Introduction

Cigarette smoking continues to be a significant contributor to morbidity and mortality across the world (Ministry of Health. Tobacco smoking, 2014; Health & Social Care Information Centre; Ministry of Health of Turkey, 2010; Centers for Disease Control and Prevention, 2010; Ministry of Health, 2013) and accounts for 12% of all deaths among adults ages 30 years and older (World Health Organization, 2012). In the United States (U.S.), despite notable declines in smoking rates since 1965, almost one in five adults (19.3%), aged 18 years and older, were current smokers in 2010 (Centers for Disease Control and Prevention, 2011). Among young adults, the rate was slightly higher at 20.1% (Centers for Disease Control and Prevention, 2014). Rates in other English-speaking developed countries and cultures are comparable: Although smoking prevalence rates have decreased over the last fifty years in Great Britain, rates have remained stable at 20% of adults 16 years of age and older over the past several years (Office for National Statistics, 2013). Rates among younger smokers are higher in Great Britain: More than one in four (29%) adults, aged 20 to 24 years, are smokers (Office for National Statistics, 2013). Rates in New Zealand are slightly lower: Recent studies suggest that 17.2% of adults, aged 15 years and older, are current smokers (Ministry of Health, 2014). In contrast, rates of cigarette smoking in Middle Eastern countries, such as Turkey, are higher. Almost one in three (31%) adults were current smokers in Turkey in 2008, although recent tobacco control efforts decreased prevalence to 27% (Ministry of Health Turkey, 2013).

Across countries and settings, smokers express a desire to quit smoking (Reeder et al., 2001; Lamkin et al., 1998; Stone and Kristeller, 1992; Ybarra et al., 2011; Thyrian et al., 2008; Footman et al., 2013; Sriha Belguith et al., 2015). Mobile phone-based smoking cessation programs that use text messaging to deliver content have emerged as an important tool in the arsenal of tobacco control efforts (Borland et al., 2013; Buller et al., 2014; Free et al., 2011; Free et al., 2009; Gritz et al., 2013; Haug et al., 2009; Hertzberg et al., 2013; Naughton et al., 2012; Naughton et al., 2014; Pollak et al., 2013; Rodgers et al., 2005; Shi et al., 2013; Skov-Ettrup et al., 2014; Whittaker et al., 2011; Ybarra et al., 2012; Ybarra et al., 2013). Text messaging overcomes structural issues (e.g., lack of services, transportation) of face-to-face programs. They are cost-effective and easy to scale up with the ever-increasing use of text messaging across the world. Reviews and meta-analyses suggest that text messaging-based programs are effective in affecting cessation and other health behaviors (Whittaker et al., 2012; Free et al., 2013; Guide to Community Preventive Services, 2011; Cole-Lewis and Kershaw, 2010; Ahmadvand et al., 2015; Spohr et al., 2015).

Despite the growing evidence that text messaging-based smoking cessation programs can positively affect quitting rates, gaps in our knowledge remain. First, our understanding is limited about for whom these programs work best, for example, whether these programs work better for heavier smokers than for lighter smokers. Second, while previous meta-analyses were based on analyses of overall effect sizes for each study and did not include analyses at the participant level (Whittaker et al., 2012; Free et al., 2013; Whittaker et al., 2009), there is a dearth of meta-analyses that analyze data at the individual participant level. This methodology, sometimes referred to as “integrative data analysis” has several advantages, including the ability to better

study the effects of participant subgroups and characteristics on outcomes, and is considered the gold standard of meta-analyses (Cochrane Individual Participant Data (IPD) Meta-analysis Methods Group; Bainter and Curran, 2015). As such, the purpose of this study was to pool data at the individual level across five text messaging for smoking cessation studies (Free et al., 2009; Rodgers et al., 2005; Ybarra et al., 2012; Ybarra et al., 2013; Abroms et al., 2014) conducted in four different countries (U.S., United Kingdom [U.K.], New Zealand, and Turkey). Once pooled, data were analyzed for overall predictors of smoking cessation, the effects of subgroups on quitting, and the effects of specific text messaging-based interventions on quitting.

2. Methods

Five text messaging-based smoking cessation programs were included in the meta-analysis: STOMP in New Zealand (Rodgers et al., 2005), txt2stop in the U.K. (Free et al., 2009), Text2Quit (Abroms et al., 2014) and Stop My Smoking (SMS) USA (Ybarra et al., 2013) in the U.S., and SMS Turkey in Ankara, Turkey (Ybarra et al., 2012). All studies were randomized controlled trials of interventions delivered primarily by text messages and compared with respective standard care. Outcomes included point prevalence and continuous abstinence at approximately 4 weeks and 3 months post-quit day, depending on when the participant responded to the assessment. Individual study results have been previously published (Free et al., 2009; Rodgers et al., 2005; Ybarra et al., 2012; Ybarra et al., 2013; Abroms et al., 2014). Studies were included by convenience: All authors agreed to share their respective entire data sets with the current study’s biostatistician. Moreover, at the time of that request, there were no other published studies of RCTs of stand-alone SMS interventions with similar cessation outcome measures. Thus, these five studies were the most similar in terms of design, outcomes, and intervention and therefore most amenable to inclusion in the integrative data analysis.

Table 1 provides an overview of each cessation program and its evaluation. Text2Quit was developed independently, txt2stop was adapted from the original STOMP program, and SMS USA and SMS Turkey were developed by the same research team. Inclusion criteria were similar across the five trials. Control programs varied (e.g., pamphlets, referral to existing services, unrelated and/or infrequent messages) but intent was similar (i.e., to provide an inactive representation of standard care). Participants received program messages most frequently during the first four weeks following the quit day, which then reduced in frequency and intensity for the rest of the intervention period. All were based on known effective cessation techniques (e.g., setting a quit day) and, to some degree, behavior change theories, including cognitive behavioral therapy (Fiore et al., 2008; Ossip-Klein and McIntosh, 2003; Lancaster et al., 2000; Lichtenstein et al., 1996; Wadland et al., 1999; Wadland et al., 2001). Points of difference include: the degree and methods for personalization and tailoring of the interventions, with Text2Quit being the most highly personalized program (e.g., messages include participant’s first name, quit date, their top three reasons for quitting, money saved by quitting (Whittaker et al., 2009)); the frequency and scheduling of messages, although all start prior to the scheduled quit day; and the inclusion of a relapse program, with the exception of STOMP.

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