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Review

Efficacy of text messaging-based interventions for health promotion: A meta-analysis

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ABSTRACT

This meta-analysis investigated the efficacy of text messaging-based health promotion interventions. Nineteen randomized controlled trials conducted in 13 countries met inclusion criteria and were coded on a variety of participant, intervention, and methodological moderators. Meta-analytic procedures were used to compute and aggregate effect sizes. The overall weighted mean effect size representing the impact of these interventions on health outcomes was $d = .329$ (95% CI = .274, .385; $p < .001$). This effect size was statistically heterogeneous ($Q_{18} = 55.60$, $p < .001$, $I^2 = 67.62$), and several variables significantly moderated the effects of interventions. Smoking cessation and physical activity interventions were more successful than interventions targeting other health outcomes. Message tailoring and personalization were significantly associated with greater intervention efficacy. No significant differences were found between text-only interventions and interventions that included texting plus other components. Interventions that used an individualized or decreasing frequency of messages over the course of the intervention were more successful than interventions that used a fixed message frequency. We discuss implications of these results for health promotion interventions that use text messaging.

Text messaging or short-message service (SMS) is a relatively simple technology for sending and receiving messages on mobile phones, and it has become a popular form of communication across the world. Messages are limited to 160 characters and can be sent from mobile phones and some Internet sites (Grinter & Eldridge, 2003). Although most commonly used for social communication, text messaging also can be applied in health promotion interventions to deliver health messages and positively influence health behaviors. In this manuscript, we describe text messaging, review previous literature on its use in health promotion interventions, and present a meta-analysis of 19 studies that report on health promotion interventions that used text messaging to change behavior.

Text messaging has far reach. Mobile phones are owned by 67% of the world's population; by 2017, estimates are that approximately eight billion mobile phones with text messaging capability will be in use (International Telecommunication Union, 2010; Portio Research, 2012). Text messaging is the most popular non-voice application on mobile phones (Lenhart, 2010). In a recent survey of 21 countries, a median of 75% of cell phone owners reported regularly sending and receiving text messages (Kohut et al., 2011). Although text messaging has widespread popularity, data suggest that it differs across population segments. For example, minority groups are more likely to send/receive text messages than Whites in the United States (Lenhart, 2010). Age also makes a difference, as U.S. teens send/receive on average 50 messages per day, whereas adults on average send/receive only 10 messages per day (Lenhart, 2010). Other research suggests text messaging is particularly popular in developing countries; in a survey of 21 countries, which included the United States, Great Britain, and China, Kohut and colleagues found text messaging was most popular in Indonesia, Kenya, and Lebanon.

Far reaching capacity is not the only advantage of this technology; it is also relatively cost effective. Because the technology involved in sending a text is very simple, the cost for wireless carriers is almost nothing (despite the fact that the cost to customers can vary considerably; Stross, 2008). Additionally, new advancements in text messaging across a variety of media, such as text messaging apps on mobile phones that can send/receive messages from other media, are predicted to drive the cost of traditional text messaging plans down due to decreased demand

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(Wortham, 2011). This low cost has appeal not only for users but also for researchers and practitioners wishing to employ this technology to reach target audiences.

Perhaps the most interesting aspect of this technology is its omnipresence. A quick scan of most settings (e.g., a classroom, a sporting event) reveals the ubiquitous presence of mobile phones. Most U.S. cell phone owners (65%) report sleeping with their cell phone either in or right next to their bed (Lenhart, 2010). One scholar argues that our very society is changing because people are constantly on their cell phones (Katz, 2007). In other words, it seems this is not a technology that must be brought to an individual or that an individual must be "driven" to use. It is a technology that is an integral part of people's lives.

Because of text messaging's arguably unprecedented potential to reach people with messages, researchers are becoming more interested in the role that it can play in health behavior change interventions. In the next section, we discuss the use of text messaging in health interventions.

Text message-based health promotion interventions

The use of text messaging in health interventions is a relatively new practice. In fact, the first formal evaluation of a health intervention using text messaging only appeared in 2002 (Neville, Greene, McLeod, Tracey, & Surie, 2002). The first randomized controlled trial (RCT) of a health promotion intervention appeared three years later (Rodgers et al., 2005). Recently, scholars have summarized the proliferation of text messaging health interventions in several systematic review articles and book chapters (Abroms, Padmanabhan, & Evans, 2012; Cole-Lewis & Kershaw, 2010; Fjeldsoe, Marshall, & Miller, 2009; Fjeldsoe, Miller, & Marshall, 2012). These reviews examine participant, intervention, and methodological characteristics of these interventions and suggest this technology is effective for delivery of health messages.

Fjeldsoe et al. (2009) conducted the first systematic review when they examined 14 health interventions that used texting to deliver health messages. They found that interventions varied widely on characteristics such as research design, intervention length, nature of texting dialog (intervention- or participant-initiated, automated or sent by a person, one-way or interactive), frequency of text messages, and message type (tailored or targeted). They concluded that this technology has much potential, with 13 of the interventions showing positive behavioral changes (although not all results were statistically significant).

Cole-Lewis and Kershaw (2010) also reviewed the use of text messaging in health interventions. They reviewed 12 studies, all of which used either a full experimental (RCT) or a quasi-experimental design, suggesting the growth of formal evaluations in the area. The review drew attention to three trends. First, text messaging interventions have global appeal; the 12 studies reviewed were conducted in nine different countries. Second, retention was relatively high in the text message-based interventions, with none of the studies falling below 68% retention at follow-up. Third this technology was an effective way to deliver messages and change health behaviors; eight of the 12 studies had statistically significant health behavior changes in the hypothesized direction. The authors concluded that research on text messaging interventions "should be approached with urgency" (p. 67), although they emphasized that researchers still have a long way to go to maximize the use of this technology to promote health behavior change.

As the literature has developed, researchers have more incisively analyzed the application of text messaging to health interventions. Two recent book chapters draw attention to three conceptual, theoretical, and methodological trends in text message-based health intervention research. First, researchers are increasingly recognizing conceptual distinctions between the purposes of interventions and types of health behaviors being addressed with text messaging. For example, Fjeldsoe et al. (2012) observe four purposes for which text messaging has been used: 1) enhancing health service provision, 2) distributing mass health education messages, 3) encouraging better disease self-management practices, and 4) delivering personalized health promotion interventions. In terms of types of health behaviors, Abroms et al. (2012) discuss the use of text messaging in health promotion interventions (e.g., smoking cessation, weight loss), which may be argued to be conceptually distinct from interventions focused on the management of chronic health conditions (e.g., diabetes, heart disease). These conceptual distinctions are important given that interventions will be designed differently (e.g., recruitment strategy, intervention length, theory selected) depending on the population and health issue targeted and the intended outcomes.

Second, there is a lack of theory-guided work in this area and particularly a lack of theory development. Research shows that some behaviors are more apt to be targeted by interventions informed by theory, such as smoking cessation and physical activity (Fjeldsoe et al., 2012). Still, many published studies of text messaging interventions are deficient in both theory application and theory testing (Fjeldsoe et al., 2012). Additionally, researchers have not engaged in theory development that is sensitive to this unique technology (Abroms et al., 2012).

Third, researchers in this area are making use of more sophisticated research designs and evaluation strategies. As previously mentioned, the first evaluation of a health intervention using texting was published in 2002. By 2010, Cole-Lewis and Kershaw located 12 studies that used a full experimental (RCT) or quasi-experimental research design. Despite the methodological progress in this area, much of the research reporting on text message-based health interventions does not employ strong research designs or evaluation strategies. As the field moves forward, Fjeldsoe et al. (2012) argue that it must continue to produce more RCTs.

The current study

Text messaging boasts mass public reach, accessibility, and low cost. Past reviews suggest text messaging-based interventions have the potential to be effective in changing health behavior. This new area of research, however, is still experiencing growing pains as researchers and public health practitioners work to determine the most efficient use of text messaging in health-related interventions. Also, as of yet, there has been no quantitative synthesis of outcomes of text messaging intervention studies. In an effort to provide a comprehensive yet focused look at the effectiveness of text messaging interventions, the current study presents a meta-analysis that investigates the effectiveness of health promotion interventions that incorporate text messaging. This study has two research questions. First, *are text messaging-based health promotion interventions efficacious?* Second, *what are the moderators of efficacious text messaging-based interventions?*

Method

Search strategy

We used a comprehensive search strategy to locate studies relevant to this meta-analysis. We did not set a date limit on the search, and we considered all applicable studies located by October 1, 2011 for inclusion.

The search strategy involved three steps. First, we conducted comprehensive searches of CINAHL, Communication & Mass Media