**Appendix A**

Use of text messaging for maternal and infant health:

A systematic review of the literature

**ABSTRACT**

**Purpose**: Text messaging is an increasingly popular communication tool in health interventions, but has been little studied in maternal and infant health. This literature review evaluates studies of text messaging that may be applied to the promotion of maternal and infant health.

**Description:** Articles from peer-reviewed journals published before June 2012 were included if they were experimental or quasi-experimental studies of behaviors endorsed either by the American College of Obstetrics and Gynecology, the American Pediatrics Association, or the United States Preventive Services Task Force; included reproductive age women (12 to 50 years) or infants up to two years of age; and were available in English. Qualitative studies of text messaging specific to pregnant women were also included. Studies were compared and contrasted by key variables, including: design, time-period, study population, and results.

**Assessment:** Forty-eight articles were included, 30 of which were randomized controlled trials.

**Conclusion:** Interventions vary greatly in effectiveness and soundness of methodology, but collectively indicate that there is a wide range of preventative behaviors that text message interventions can effectively promote, including smoking cessation, diabetes control, appointment reminders, medication adherence, weight loss, and vaccine uptake. Those interventions that are based on an established theory of behavior change and use motivational as opposed to informational language are more likely to be successful.

**INTRODUCTION**

 Text messaging has become a routine and inexpensive method of communication around the world. In a 2011 Pew Research Center survey of people in 21 representative countries, 75% of cell phone owners communicated via text, and text messaging was more common in the poorest nations ([1](#_ENREF_1)). In a survey of cell phone owners the same year in the United States, 73% of cell phone users overall used text messaging, and 95% of 18-29 year old cell phone owners used text messaging ([2](#_ENREF_2)). The same survey also found that those who are poor and less educated are more likely to use text messaging and send a higher average number of texts daily. Those identified as black, non-Hispanic sent an average of 70.1 texts a day, compared to 31.2 texts for whites. Text messaging is thus a potentially powerful medium for communicating health messages to underserved populations, such as the young, impoverished, and less educated.

 Several review articles have indicated that text messaging is an effective tool for a variety of health behavior changes, including smoking cessation, medication adherence, and diabetes management ([3-6](#_ENREF_3)). Most of the target groups in these studies are patients with chronic diseases, especially diabetes and asthma, or those with unhealthy lifestyle factors, such as obesity and smoking. The delivery of text messages to healthy populations is less well studied.

 One potential area for expansion of text messaging as a public health tool is in maternal health, including preconception health and infant care. Pregnant women and mothers of young children fall into the age groups most likely to use text messaging, and many behaviors in the prenatal and postpartum period have been identified as important targets for improving birth outcomes for women and their children. A few text message interventions have targeted pregnant and postpartum women exclusively. These include the nationwide text4Baby program, which provides text messages to pregnant and postpartum women, timed to their due date. Text4Baby launched nationally in the United States in 2010 ([7](#_ENREF_7)).

 While few text message interventions have specifically targeted pregnant women or infants, many have explored issues that are of particular importance to maternal health. The goal of this review article is to identify studies of interventions relevant to the use of text messaging related to maternal health and infant care. Relevant studies were critically evaluated to assess if text messages can impact knowledge, attitudes, and behaviors in preconception, prenatal, postpartum, and early infant care. Based on this literature review, considerations are offered to guide future research.

**METHODS**

 Five databases were searched for experimental or quasi-experimental trials of behavioral interventions delivered by text message. The databases searched were Embase, Pubmed, CINAHL, Web of Science, and PsycInfo. Titles and abstracts were searched for the following terms: “cell phone,” “text message,” “mobile phone,” “texting,” “SMS,” or “mhealth” combined with “health,” “maternal health,” “pregnancy,” and “infants.” In addition, meta-analyses on topics in mhealth were hand-searched. The primary search was conducted in June, 2012. All articles published before 2012 were eligible for inclusion. We also included the only evaluation of Text4baby in the literature, published after the initial search.

 To be included, studies had to focus on interventions recommended in the preconception, prenatal, or postpartum period or in the care of infants by at least one of three organizations: The American College of Obstetrics and Gynecology, the American Pediatrics Association, or the United States Preventive Services Task Force. Studies had to include reproductive age women (12 to 50 years) or infants up to two years of age; and be available in English. Interventions that utilized other communication methods were included only if text messaging was the primary mode of communication. Given the lack of studies specific totargeting the specified population, qualitative and pilot studies of text messaging interventions were included if targeted exclusively at this population.

 A two-step exclusion process identified relevant articles. First, the titles and abstracts were reviewed to determine if they met inclusion and exclusion criteria. Each article was read to further determine if it met the criteria. Articles were then divided into interventions of primary importance in three time period groupings: the preconception period, pregnancy, and postpartum and infancy. For the preconception period, studies focused on family planning, the treatment and prevention of sexually transmitted diseases, and vitamin adherence. In the pregnancy category, studies addressed increased access to and utilization of outpatient care, smoking cessation, substance abuse, and diabetes control. Studies related to postpartum and infant care included those related to weight loss, depression, and vaccine promotion. We critically reviewed articles as a whole, and compared each by objective, text message intervention, bidirectionality of messaging, supportive interventions, design, population, and findings.

**RESULTS**

 The search initially identified 1,311 unique articles (Figure 1). After reviewing titles and abstracts, a total of 251 articles met initial inclusion criteria. After reading each article, 48 were found to meet all inclusion and exclusion criteria. These included: 30 randomized controlled trials; two non-randomized or partially randomized controlled trials; two cohort studies; three uncontrolled trials; five cross-sectional or ecological studies; three pilot studies; two historical case controls; and one focus group (Table 1). Only six studies specifically targeted pregnant women, and one specifically targeted infants.

***PRECONCEPTION PERIOD***

**Family planning**

 Two randomized controlled trials used text messaging to promote adherence to oral contraceptives (Table 2). In the first, published in 2010 and conducted in a Boston Planned Parenthood Clinic, the intervention group received the same message at the same time every day ([8](#_ENREF_8)). There was no statistical difference in the primary outcome, number of pills missed per cycle. In contrast, a study published in 2012 found that those that received a daily, unique informational message about the health effects of oral contraceptives were 10% more likely to adhere to ­oral contraceptive pill (OCP) use at 6 month follow-up ([9](#_ENREF_9)). Twelve messages also allowed participants to text back regarding their experience with the program.

**Sexually-transmitted infections**

Twelve studies of sexually-transmitted infections were targeted to both men and women. One study focused directly at sexual health promotion through text message campaigns. This study recruited mobile phone subscribers in Australia, ages 16-29, from a music festival in Melbourne, Australia ([10](#_ENREF_10)). Participants received a total of twelve educational messages over five months. Results indicated a significant increase in sexual health knowledge and sexually transmitted infection (STI) testing. However, the effect on behaviors was mixed, with participants reporting a reduction in the number of new partners but less consistent condom use.

 Four studies tested the viability of text messages for communicating STI test results. Two patient surveys, one conducted in Ireland and one conducted in London, indicated that patients would not prefer to receive text message notification of STI results over conventional means of communication, such as phone calls and mailings ([11](#_ENREF_11), [12](#_ENREF_12)). However, two randomized controlled trials comparing text message to conventional means of results communication found that either there was no difference between the text message and conventional notification in time-to-treatment of STI, or that text message was superior ([6](#_ENREF_6), [13](#_ENREF_13)).

**HIV**

 Two large-scale studies looked at the use of mobile phones to promote HIV awareness and testing in Uganda and South Africa ([14](#_ENREF_14), [15](#_ENREF_15)). In the Ugandan study, researchers sent HIV quiz questions to 10,000 mobile phone subscribers identified by a local telecommunications company in an uncontrolled trial. One fifth responded to any of the text messages, and only 233 of participants accessed free HIV testing. Lack of a comparison in this study made it difficult to determine the effect of the intervention. In the South African study, mobile phone users were randomized to receive either motivational messages (encouraging them to get tested), or informational text messages (explaining the importance of getting tested), versus a control group that received no messages. Only those that received motivational messages were significantly more likely to seek HIV counseling and testing services.

 Several studies evaluated the effectiveness of text messages in promoting adherence to highly active antiretroviral (HAART) therapy among those with HIV. The two largest (n=431 and n=538), both conducted in Kenya, found that patients receiving weekly text message reminders had slightly increased adherence compared to those who received no messages ([16](#_ENREF_16), [17](#_ENREF_17)). In the group receiving daily text message reminders, however, there was no significant increase in adherence. A smaller study (n=19) in Brazil found no significant increase in self-reported medication adherence, while a study in Italy found a significant increase in self-reported adherence and viral suppression ([18](#_ENREF_18), [19](#_ENREF_19)). Finally, an uncontrolled trial examined the accuracy of self-reported adherence, demonstrating that participants reported adherence of 90.3%, versus 53.6% recorded by electronic bottle cap monitoring (MEMS) ([20](#_ENREF_20)).

**Vitamin supplementation**

One study used text message to promote routine vitamin use. In a small (n=102) randomized controlled trial published in 2009, male and female students at a Canadian university were randomized to receive a daily text message promoting vitamin use, or simply report adherence at the end of the study. Participants in the intervention group received a daily text message reminder with content that was either informational or motivational. Participants were able to text back whether they had taken their vitamin that day. The researchers found no significant difference in the number of pills missed weekly ([21](#_ENREF_21)).

***PREGNANCY PERIOD***

**Comprehensive pregnancy education programs**

Two studies, both conducted in Thailand, reported on comprehensive prenatal care programs (Table 3). The first, an RCT published in 2008, sent biweekly informational text messages regarding warning signs in pregnancy, versus usual care in the control ([22](#_ENREF_22)). The intervention group was more likely to be satisfied with their prenatal care, but did not differ from controls in delivery outcomes. The second study used text messages to remind women along the Thai/Myanmar border about their scheduled prenatal and childhood immunization appointments ([23](#_ENREF_23)). They found a significant increase in the number of participants who kept their scheduled appointments compared to a historical control.

 One pilot program in Virginia evaluated text message effectiveness amongst pregnant women enrolled ([24](#_ENREF_24)). Researchers randomly allocated 123 women recruited from the Fairfax health department to text4baby plus usual care (intervention group) versus usual care alone (control group), and tested agreement with eight statements related to prenatal health. They found that the intervention group was significantly more likely to agree with the statement “I am prepared to be a new mother;” all other differences were not significant, which may reflect the small sample size.

**Clinic attendance**

 No studies were identified that specifically looked at prenatal care appointments; however, six randomized controlled trials assessed the efficacy of text message appointment reminders at various outpatient clinics to reduce the no-show rate at outpatient appointments ([25-30](#_ENREF_25)). Four of these six studies found that text messaging was an effective and efficient appointment reminder tool, one found no statistical difference, and one found text message to be inferior to voicemail reminders. Four other studies that used historical controls found that text messaging reduced no-shows over no reminder, and required fewer hours than phone calls to implement ([31-34](#_ENREF_31)).

**Smoking cessation**

 Six studies were identified that examined the use of text messaging in smoking cessation: four randomized controlled trials and two pilot studies. One of these specifically targeted pregnant smokers recruited from midwifery practices in the UK ([35](#_ENREF_35)). Pregnant women received up to two messages a day for eleven weeks, tailored to a baseline questionnaire about their motivations for quitting. No difference was found in smoking rates at twelve weeks. Another study of university students recruited from a German university cafeteria found no difference in smoking rates was observed in two intervention groups, where participants received one or three messages a week for three months, compared to a control group which received no messages ([36](#_ENREF_36)). In contrast, two studies found text messages significantly increased quit rates. One study conducted in New Zealand sent participants up to five messages a day, timed to their quit date, and found quit rates to be 2.2 times higher at six weeks than in a control (which received one message every two weeks thanking them for their participation in the study) ([37](#_ENREF_37)) Another RCT of smokers in the UK using the same number of text messages found that smoking abstinence at six months continued to be higher in the intervention group, though quit rates overall were low ([38](#_ENREF_38)). Two pilot studies found participants had high quit rates and high levels of satisfaction with text messaging support programs ([39](#_ENREF_39), [40](#_ENREF_40)).

**Substance abuse**

One study examined text messaging to reduce substance abuse among young adults presenting to an emergency room who screened positive for alcohol abuse ([41](#_ENREF_41)). Young adults were recruited from the emergency department and randomized to one of three groups: a control group, who received a reminder to complete a follow-up survey; an assessment group, where participants were asked how much they had drunk in the previous week; and an intervention group, where participants were texted feedback depending on the number of drinks they reported. The study enrolled only 45 participants, and found no statistically significant difference in the number of heavy drinking days. However, there was a trend to fewer heavy drinking days in the control and intervention group, and a slight increase in the assessment group.

**Diabetes**

 Three studies focused on the effective management of diabetes. A semi-randomized trial conducted in Spain targeted women treated for gestational diabetes ([42](#_ENREF_42)). Insulin-dependent women were placed in the intervention group and all others were randomized. The intervention group texted their provider weekly glucose measurements, and providers responded with recommendations; the control group received standard care. No significant difference was found between the intervention and control group’s diabetic control, but women who were insulin-dependent had a significant reduction in outpatient visits. One study showed an improvement in A1c for those receiving messages from an endocrinology nurse; [43](#_ENREF_43) and one showed stable A1c in those receiving automated messages based on their baseline survey compared to a slight worsening in controls. [44](#_ENREF_44) ***POSTPARTUM AND INFANT CARE PERIOD***

**Weight loss and activity**

 Three randomized controlled trials were identified that used text messaging for weight loss in men and women (Table 4). All three studies allocated participants to a control group versus a two-way text message intervention where participants texted their weights to researchers and received feedback. All three found the intervention group lost significantly more weight than the control group participants ([43-45](#_ENREF_43)). Two studies using text messages to promote exercise found modest increases in weekly exercise, though they were both short-term, one lasting two weeks and the other lasting four weeks ([46](#_ENREF_46), [47](#_ENREF_47)).

**Depression**

 Only one study on depression met all inclusion criteria. This study was conducted in New Zealand and provided all interested high school students with text and video messages ([48](#_ENREF_48)). In the intervention group, participants received messages based on cognitive behavioral theory, and those in the control received general health promotion messages to control for attention and desirability bias. Those in the intervention group were significantly more likely than the control to believe that the messages helped them to be more positive and get rid of negative thoughts ([48](#_ENREF_48)).

**Vaccinations**

 In a focus group of 40 pregnant women , only half had received influenza vaccine in the previous year. Participants reported that while they did not believe that the text messages would directly change their opinions regarding vaccines, they would make them more likely to discuss the influenza vaccine with their provider ([49](#_ENREF_49)). Two RCTs recruited parents of children at low-income pediatrics clinics to promote infant and childhood vaccines ([50](#_ENREF_50), [51](#_ENREF_51)). The first did not show a significant difference in adherence to vaccination schedule, but the authors noted that 40% of participants experienced a service disruption. The second study showed a small but significant increase in adherence (43.1% vs. 39%). This may reflect its larger sample size, with 7,574 participants versus 90 in the first study. A cohort study published in 2011 of parents at five separate pediatric clinics demonstrated that children of parents who received text message reminders were more likely to complete the Human papillomavirus vaccine course than those who did not ([52](#_ENREF_52)).

**DISCUSSION**

 These studies demonstrate the potential applicability of text messaging to health promotion in maternal and infant health, as well as some areas that need further exploration. Several of the interventions reviewed provide compelling preliminary evidence that smoking cessation, diabetes control, appointment reminders, medication adherence, weight loss, and vaccine uptake are amenable to and aided by this technology. Other targets relevant to maternal and infant health, including STI education, vitamin adherence, substance abuse, and depression have not been adequately studied, and specifically, have not been studied in the populations relevant to maternal and child health. This is largely consistent with a separate review published in 2012, which was limited to articles that studied maternal and infant health directly and returned a total of thirty articles, four of which were quantitative ([53](#_ENREF_53)). Finally, the comprehensive pregnancy education programs are difficult to evaluate due to their wide-ranging goals and outcomes measures.

 Based on this literature review, five lessons emerge for researches in this field. First, databases have yet to create a systematic way of classifying these articles, making it difficult to find relevant articles. Databases could help overcome the difficulty of identifying relevant articles by classifying articles with a standard term. We suggest “mhealth”—short for “mobile health”—which is emerging as the most popular term among researchers and has the specificity of comprehensiveness necessary to be a useful research term.

 Second, interventions should follow established theoretical models more closely. Those studies discussed with the most compelling evidence for effective behavioral change share a relatively more rigorous application of theories of behavior change, especially the transtheoretical model, also known as the “stages of change” model. Using this theory, the study directors are able to target messages and modify content to established stages of change, especially in several of the smoking interventions ([37](#_ENREF_37), [38](#_ENREF_38)). Thus, they incorporate this new technology into what is already known about successful models of intervention. For example, the Agency for Healthcare Research and Quality review of health literacy interventions found that effective interventions were distinguished by “their high intensity, theory basis, pilot testing before full implementation, emphasis on skill building, and delivery of the intervention by a health professional” ([54](#_ENREF_54)). Using established theories of behavioral change appears to be as important in text message interventions as it is in other behavioral interventions.

Third, researchers should choose motivational messages over informational messages, and vary message timing and content to maintain engagement. In directly comparing motivational to educational text messages, one study found that motivational messages were effective, while educational messages were not ([15](#_ENREF_15)). In the smoking interventions discussed, one study used strictly motivational messages and ultimately had more long-term success than a similar intervention that used a combination of motivational and educational messages ([37](#_ENREF_37), [38](#_ENREF_38)). This is a preliminary finding, but indicates that if program designers have a choice, motivational messages are preferable.. Researchers should also vary the content and timing of the message, especially in medication adherence interventions. Though medications reminders were effective in the three studies ([9](#_ENREF_9), [16](#_ENREF_16), [17](#_ENREF_17)), those groups that received the same message at the same time of day did not show an improvement in adherence ([8](#_ENREF_8), [16](#_ENREF_16)). Receiving the same message at the same time of day may increase the likelihood that participants will ignore the message over time. Finally, the study that compared self-reported adherence versus electronic monitoring both invites caution in interpreting these results and provides evidence that researchers could make use of other types of technology to improve accuracy in measuring outcomes of adherence interventions ([20](#_ENREF_20)).

Fourth, the outcomes of the text messaging programs need to be more closely aligned to the content. This is especially true of programs that send participants a wide variety of messages on various topics, including STI and HIV education, and the comprehensive pregnancy education programs ([10](#_ENREF_10), [14](#_ENREF_14), [22-24](#_ENREF_22)). The lack of a clear outcome precludes effective measurement of the intervention’s efficacy, and therefore hampers the intervention’s refinement, as other authors have noted ([53](#_ENREF_53), [55](#_ENREF_55)). Narrowing the intervention to a specific purpose could therefore help researchers to apply theories of behavior change, as well as to measure the effectiveness of their program. Other methodological issues include the fact that many studies were not randomized controlled trials, and those that were rarely accounted for attention effect.

Finally, researchers need to closely examine the reasons for high drop-off rates and perhaps provide more support to participants. Of the nine that included more than 200 participants, only four had more than 80% follow-up: one of these provided cell phones to participants ([56](#_ENREF_56)); one had participants text their interest and consent to researchers, demonstrating their interest and comfort with the medium ([38](#_ENREF_38)); and one scheduled follow-up interviews with high school during school hours ([48](#_ENREF_48)). The last is distinguished in its design by the personalization of messages to participants’ baseline information, and the integration of the program into their care ([57](#_ENREF_57)). Determining what leads to successful retention in these programs is essential to designing an intervention that can be evaluated and scaled up beyond a pilot study. Very little data is currently available on what leads to drop-off and how it might be prevented. One of the studies of influenza vaccine messages noted that 40% of participants experienced a service disruption during the intervention ([50](#_ENREF_50)). One solution would be for researchers to pay for cell phone service during participation, which could prevent drop-off.

Even in the absence of infrastructure issues, participants must perceive these programs as valuable to keep participation high. Those programs that allow two-way messaging and feedback appear to be relatively more successful, such as the three weight loss RCTs ([43-45](#_ENREF_43)). Another way to reinforce the intervention is by integrating multiple platforms, such as website feedback in one study of Hgb A1c control, or the use of the QUIT number in messages as in the successful smoking interventions ([37](#_ENREF_37), [38](#_ENREF_38), [58](#_ENREF_58)). Providers likewise must see improvement in time, costs, or other relevant measures. Finally, text message programs should link participants with existing infrastructure to support and sustain their behavioral improvements.

The use of text messages to promote maternal health has tremendous potential to reach pregnant women and new mothers, particularly those with fewer resources. These women are traditionally more difficult to integrate into health programs, while at the same time they are likely to use text messaging and have the most potential to gain from such programs. Future studies could add much to the existing literature by focusing on underserved populations, as mhealth continues to be utilized as a tool for advancing public health.

**References**

1. Wike R. Global Digital Communication: Texting, Social Networking Popular Worldwide. *Pew Global Attitudes Project* 2011:1-29.

2. Smith A. Americans and text messaging. *Pew Research Center* 2011:1-14.

3. Cole-Lewis H, Kershaw T. Text messaging as a tool for behavior change in disease prevention and management. *Epidemiol Rev* 2010;32(1):56-69.

4. Holtz B, Lauckner C. Diabetes management via mobile phones: a systematic review. *Telemed J E Health* 2012;18(3):175-84.

5. Whittaker R, Borland R, Bullen C, et al. Mobile phone-based interventions for smoking cessation. *Cochrane Database Syst Rev* 2009(4):CD006611.

6. Lim EJ, Haar J, Morgan J. Can text messaging results reduce time to treatment of Chlamydia trachomatis? *Sexually Transmitted Infections* 2008;84(7):563-4.

7. Parker RM, Dmitrieva E, Frolov S, et al. Text4baby in the United States and Russia: An Opportunity for Understanding How mHealth Affects Maternal and Child Health. *J Health Commun* 2012;17 Suppl 1:30-6.

8. Hou MY, Hurwitz S, Kavanagh E, et al. Using daily text-message reminders to improve adherence with oral contraceptives: a randomized controlled trial. *Obstet Gynecol* 2010;116(3):633-40.

9. Castano PM, Bynum JY, Andres R, et al. Effect of daily text messages on oral contraceptive continuation: a randomized controlled trial. *Obstet Gynecol* 2012;119(1):14-20.

10. Gold J, Lim MSC, Hocking JS, et al. Determining the Impact of Text Messaging for Sexual Health Promotion to Young People. *Sexually Transmitted Diseases* 2011;38(4):247-52.

11. Brugha R, Balfe M, Conroy RM, et al. Young adults' preferred options for receiving chlamydia screening test results: a cross-sectional survey of 6085 young adults. *Int J STD AIDS* 2011;22(11):635-9.

12. Brown L, Copas A, Stephenson J, et al. Preferred options for receiving sexual health screening results: a population and patient survey. *International Journal of Std & Aids* 2008;19(3):184-7.

13. Menon-Johansson AS, McNaught F, Mandalia S, et al. Texting decreases the time to treatment for genital Chlamydia trachomatis infection. *Sexually Transmitted Infections* 2006;82(1):49-51.

14. Chib A, Wilkin H, Ling LX, et al. You Have an Important Message! Evaluating the Effectiveness of a Text Message HIV/AIDS Campaign in Northwest Uganda. *J Health Commun* 2012;17 Suppl 1:146-57.

15. de Tolly K, Skinner D, Nembaware V, et al. Investigation into the Use of Short Message Services to Expand Uptake of Human Immunodeficiency Virus Testing, and Whether Content and Dosage Have Impact. *Telemedicine and E-Health* 2012;18(1):18-23.

16. Pop-Eleches C, Thirumurthy H, Habyarimana JP, et al. Mobile phone technologies improve adherence to antiretroviral treatment in a resource-limited setting: A randomized controlled trial of text message reminders. *AIDS* 2011;25(6):825-34.

17. Lester RT, Ritvo P, Mills EJ, et al. Effects of a mobile phone short message service on antiretroviral treatment adherence in Kenya (WelTel Kenya1): a randomised trial. *Lancet* 2010;376(9755):1838-45.

18. da Costa TM, Peres Barbosa BJ, Gomes e Costa DA, et al. Results of a randomized controlled trial to assess the effects of a mobile SMS-based intervention on treatment adherence in HIV/AIDS-infected Brazilian women and impressions and satisfaction with respect to incoming messages. *International Journal of Medical Informatics* 2012;81(4):257-69.

19. Ammassari A, Trotta MP, Shalev N, et al. Timed short messaging service improves adherence and virological outcomes in HIV-1-infected patients with suboptimal adherence to antiretroviral therapy. *J Acquir Immune Defic Syndr* 2011;58(4):e113-5.

20. Harris LT, Lehavot K, Huh D, et al. Two-Way Text Messaging for Health Behavior Change Among Human Immunodeficiency Virus-Positive Individuals. *Telemedicine Journal and E-Health* 2010;16(10):1024-9.

21. Cocosila M, Archer N, Haynes RB, et al. Can wireless text messaging improve adherence to preventive activities? Results of a randomised controlled trial. *International Journal of Medical Informatics* 2009;78(4):230-8.

22. Jareethum R, Titapant V, Tienthai C, et al. Satisfaction of healthy pregnant women receiving short message service via mobile phone for prenatal support: A randomized controlled trial. *Journal of the Medical Association of Thailand* 2008;91(4):458-63.

23. Kaewkungwal J, Singhasivanon P, Khamsiriwatchara A, et al. Application of smart phone in "Better Border Healthcare Program": a module for mother and child care. *BMC Med Inform Decis Mak* 2010;10:69.

24. Evans WD, Wallace J, Snider J. Pilot evaluation of the text4baby mobile health program. *Biomed Central Public Health* 2012;12:1031-48.

25. Chen ZW, Fang LZ, Chen LY, et al. Comparison of an SMS text messaging and phone reminder to improve attendance at a health promotion center: a randomized controlled trial. *J Zhejiang Univ Sci B* 2008;9(1):34-8.

26. Leong KC, Chen WS, Leong KW, et al. The use of text messaging to improve attendance in primary care: a randomized controlled trial. *Family Practice* 2006;23(6):699-705.

27. Fairhurst K, Sheikh A. Texting appointment reminders to repeated non-attenders in primary care: randomised controlled study. *Qual Saf Health Care* 2008;17(5):373-6.

28. Nelson TM, Berg JH, Bell JF, et al. Assessing the effectiveness of text messages as appointment reminders in a pediatric dental setting. *J Am Dent Assoc* 2011;142(4):397-405.

29. Prasad S, Anand R. Use of mobile telephone short message service as a reminder: the effect on patient attendance. *Int Dent J* 2012;62(1):21-6.

30. Taylor NF, Bottrell J, Lawler K, et al. Mobile telephone short message service reminders can reduce nonattendance in physical therapy outpatient clinics: a randomized controlled trial. *Arch Phys Med Rehabil* 2012;93(1):21-6.

31. Downer SR, Meara JG, Da Costa AC. Use of SMS text messaging to improve outpatient attendance. *Medical Journal of Australia* 2005;183(7):366-8.

32. Geraghty M, Glynn F, Amin M, et al. Patient mobile telephone 'text' reminder: a novel way to reduce non-attendance at the ENT out-patient clinic. *Journal of Laryngology and Otology* 2008;122(3):296-8.

33. Sims H, Sanghara H, Hayes D, et al. Text message reminders of appointments: A pilot intervention at four community mental health clinics in London. *Psychiatric Services* 2012;63(2):161-8.

34. da Costa TM, Salomao PL, Martha AS, et al. The impact of short message service text messages sent as appointment reminders to patients' cell phones at outpatient clinics in Sao Paulo, Brazil. *International Journal of Medical Informatics* 2010;79(1):65-70.

35. Naughton F, Prevost AT, Gilbert H, et al. Randomized Controlled Trial Evaluation of a Tailored Leaflet and SMS Text Message Self-help Intervention for Pregnant Smokers (MiQuit). *Nicotine Tob Res* 2012;14(5):569-77.

36. Haug S, Meyer C, Schorr G, et al. Continuous individual support of smoking cessation using text messaging: A pilot experimental study. *Nicotine & Tobacco Research* 2009;11(8):915-23.

37. Rodgers A, Corbett T, Bramley D, et al. Do u smoke after txt? Results of a randomised trial of smoking cessation using mobile phone text messaging. *Tob Control* 2005;14(4):255-61.

38. Free C, Knight R, Robertson S, et al. Smoking cessation support delivered via mobile phone text messaging (txt2stop): a single-blind, randomised trial. *Lancet* 2011;378(9785):49-55.

39. Obermayer JL, Riley WT, Asif O, et al. College smoking-cessation using cell phone text messaging. *J Am Coll Health* 2004;53(2):71-8.

40. Abroms LC, Ahuja M, Kodl Y, et al. Text2Quit: Results From a Pilot Test of a Personalized, Interactive Mobile Health Smoking Cessation Program. *J Health Commun* 2012;17 Suppl 1:44-53.

41. Suffoletto B, Callaway C, Kristan J, et al. Text-Message-Based Drinking Assessments and Brief Interventions for Young Adults Discharged from the Emergency Department. *Alcoholism-Clinical and Experimental Research* 2012;36(3):552-60.

42. Perez-Ferre N, Galindo M, Fernandez MD, et al. The outcomes of gestational diabetes mellitus after a telecare approach are not inferior to traditional outpatient clinic visits. *Int J Endocrinol* 2010;2010:386941.

43. Donaldson EL. A text message-based weight management intervention for overweight adults *Journal of Human Nutrition and Dietetics* 2011;24:385-6.

44. Haapala I, Barengo NC, Biggs S, et al. Weight loss by mobile phone: a 1-year effectiveness study. *Public Health Nutr* 2009;12(12):2382-91.

45. Patrick K, Raab F, Adams MA, et al. A text message-based intervention for weight loss: randomized controlled trial. *J Med Internet Res* 2009;11(1):e1.

46. Prestwich A, Perugini M, Hurling R. Can implementation intentions and text messages promote brisk walking? A randomized trial. *Health Psychol* 2010;29(1):40-9.

47. Sirriyeh R, Lawton R, Ward J. Physical activity and adolescents: An exploratory randomized controlled trial investigating the influence of affective and instrumental text messages. *British Journal of Health Psychology* 2010;15:825-40.

48. Whittaker R, Merry S, Stasiak K, et al. MEMO--a mobile phone depression prevention intervention for adolescents: development process and postprogram findings on acceptability from a randomized controlled trial. *Journal of Medical Internet Research* 2012;14(1):e13.

49. Kharbanda EO, Vargas CY, Castano PM, et al. Exploring pregnant women's views on influenza vaccination and educational text messages. *Prev Med* 2011;52(1):75-7.

50. Ahlers-Schmidt CR, Chesser AK, Nguyen T, et al. Feasibility of a randomized controlled trial to evaluate Text Reminders for Immunization Compliance in Kids (TRICKs). *Vaccine* 2012;30(36):5305-9.

51. Stockwell MS, Kharbanda EO, Martinez RA, et al. Effect of a text messaging intervention on influenza vaccination in an urban, low-income pediatric and adolescent population: a randomized controlled trial. *JAMA* 2012;307(16):1702-8.

52. Kharbanda EO, Stockwell MS, Fox HW, et al. Text message reminders to promote human papillomavirus vaccination. *Vaccine* 2011;29(14):2537-41.

53. Tamrat T, Kachnowski S. Special Delivery: An Analysis of mHealth in Maternal and Newborn Health Programs and Their Outcomes Around the World. *Maternal and Child Health Journal* 2012;16:1092-101.

54. Berkman N, Sheridan S, Donahue K, et al. Health Literacy Interventions and Outcomes: An Updated Systematic Review. In: International R, ed. Research Triangle Park, North Carolina: Agency for Healthcare Research and Quality, March 2011.

55. Editors TPM. A Reality Checkpoint for Mobile Health: Three Challenges to Overcome. *Plos Medicine* 2013;10(2):1-2.

56. Pop-Eleches C, Thirumurthy H, Habyarimana JP, et al. Mobile phone technologies improve adherence to antiretroviral treatment in a resource-limited setting: a randomized controlled trial of text message reminders. *Aids* 2011.

57. Naughton F. Randomized Controlled Trial Evaluation of a Tailored Leaflet and SMS Text Message Self-Help Intervention for Pregnant Smokers. *Nicotine & Tobacco Research* 2012;14(5):569-77.

58. Kim HS. A randomized controlled trial of a nurse short-message service by cellular phone for people with diabetes. *Int J Nurs Stud* 2007;44(5):687-92.



**Table 1: Included Studies by Type, Author, and Year**

|  |  |  |
| --- | --- | --- |
| **Type of Study** | **Author** | **Year (Reference Number)** |
| Randomized Controlled Trial |  |  |
|  | Rodgers | 2005 (37)  |
|  | Kim | 2007 (43) |
|  | Leong | 2007 (26) |
|  | Chen | 2008 (25) |
|  | Fairhurst | 2008 (27) |
|  | Jareethum | 2008 (22) |
|  | Cocosila | 2009 (21) |
|  | Haapala | 2009 (46) |
|  | Haug | 2009 (36) |
|  | Patrick | 2009 (47) |
|  | Hou | 2010 (8) |
|  | Lester | 2010 (17) |
|  | Prestwich | 2010 (48) |
|  | Sirriyeh | 2010 (49) |
|  | Donaldson | 2011 (45) |
|  | Free | 2011 (38) |
|  | Gold | 2011 (10) |
|  | Nelson | 2011 (28) |
|  | Pop-Eleches | 2011 (16) |
|  | Ahlers-Schmidt | 2012 (52) |
|  | Castano | 2012 (9) |
|  | de Tolly | 2012 (15) |
|  | da Costa | 2012 (18) |
|  | Evans | 2012 (24) |
|  | Naughton | 2012 (35) |
|  | Prasad | 2012 (29) |
|  | Stockwell | 2012 (53) |
|  | Suffoletto | 2012 (41) |
|  | Taylor | 2012 (30) |
|  | Whittaker | 2012 (50) |
|  |  |  |
| Non-randomized controlled trials | Menon-Johannson | 2006 (13) |
|  | Perez-Ferre | 2010 (42) |
|  |  |  |
| Cohort studies | Lim | 2008 (6) |
|  | Kharbanda | 2011 (54) |
|  |  |  |
| Uncontrolled trials | Harris | 2010 (20) |
|  | Ammassari | 2011 (19) |
|  | Chib | 2012 (14) |
|  |  |  |
| Cross-sectional and ecological studies | Brown | 2008 (12) |
|  | Da Costa | 2010 (34) |
|  | Kaewkungwal | 2010 (23) |
|  | Brugha | 2011 (11) |
|  | Sims | 2012 (33) |
|  |  |  |
| Pilot Studies | Obermayer | 2004 (39) |
|  | Abroms | 2012 (40) |
|  | Mulvaney | 2012 (44) |
|  |  |  |
| Historical case-control | Downer | 2005 (31) |
|  | Geraghty | 2011 (32) |
|  |  |  |
| Focus Group | Kharbanda | 2011 (51) |

**Table 2: Studies of Text Message Interventions During the Preconception Period**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Topic** | **Reference (Author, yr, ref#)** | **Study objective** | **Text message intervention** | **Two-way** | **Other study interventions** | **Study design** | **Target population** | **Findings** |
| **Family Planning** | Hou 2010 (8) | Number of oral contraceptives missed per cycle | Daily medication reminder sent for three months | No | None | RCT | New users of oral contraceptives at a Boston Planned Parenthood clinic who returned for a second appointment (N=82) | No significant difference in number of pills missed per cycle between the text message intervention and the control group (4.9 intervention vs. 4.6 control, p=.60) |
| Castano 2012 (9) | Primary: OCP continuation at 6 months; Secondary: Adherence to OCP schedule | Daily text messages on the risks and benefits of OCP | Yes (12 quality control messages) | None | RCT | Women under 25 recruited from a Planned Parenthood clinic in New York (N=968) | Intervention group had 10% increase in OCP use at follow up and 11% increase in adherence, p<.01 |
| **Sexually transmitted diseases**HIV | Gold 2011 (10) | Changes in sexual health knowledge, condom use, treatment for STDs | Twelve educational messages sent over five months | No | None | RCT | Mobile phone subscribers ages 16-29 in Australia (N=3803, 185 completed follow up) | Intervention group showed an increase in knowledge (p=.02), but no change in condom use or STI screening |
| Brugha 2011 (11) | Preferred method of communication for Chlamydia test results | Text messages of STI results and appointment reminders | NA | NA | Cross-sectional survey | 18-29 year olds at several clinical sites in Ireland (N=6085) | 4.7% and 8.9% of respondents preferred a text message with a positive and negative chlamydia results, respectively; 23.9% preferred SMS reminders of clinical appointments (third most popular) p<.01 |
| Brown 2008 (12) | Acceptability of various forms of notification of STI test results | Text messages of STI results | NA | NA | Cross-sectional survey | Patients at an STI in Birmingham, UK clinic and surrounding neighborhoods (N=746) | Less than 5% preferred text message to in-person or face-to-face results |
| Lim 2008 (6) | Improved time to treatment for Chlamydia trachomatis | Message asking patients with positive results to call the clinic | No | None | Cohort study with historical control | Cases of Chlamydia trachomatis at a GU clinic in New Zealand that were not treated immediately (N=303) vs. unmatched historical controls (N=293) | No significant difference in time to treatment in the intervention group (4 days) and historical controls (3 days) p>.05 |
| Menon-Johannson 2006 (13) | 1) Improved time to treatment of Chlamydia trachomatis2) Improved efficiency of staff time | Message asking patients with positive results to call the clinic | No | None | Non-randomized cohort study | Cases of questionable Chlamydia trachomatis at a genitourinary medicine clinic in London (N=952) | 1) Estimated 46 hours/month of staff time saved; 2) Mean time to treatment was 7.9 days in the intervention group vs. 11.2 days in the control group (p=.005) |
| Chib 2012 (14) | Participation in a mass HIV education campaign to encourage HIV counseling and testing | SMS quiz questions delivered and correct answers provided to those who responded | Yes | None | Uncontrolled trial | Ugandan mobile phone subscribers (N=10,000) | 2.3% of participants accessed HIV counseling and testing; only 23.6% of the sample responded to at least one message |
|  | de Tolly 2012 (15) | Primary: Efficacy of SMS reminders to encourage HIV testing; Secondary: type and dose of SMS reminders considered effective | Informational text messages (three or ten total) and motivational text messages (three or ten) sent to participants to encourage HIV testing | Yes | None | RCT (in five arms) | South African adult mobile phone users (N=2533) | Only ten total motivational text messages demonstrated a significant increase in HIV testing (OR=1.7; p=.0036) |
| Pop-Eleches 2011 (16) | Adherence to Haart regimens | Daily or weekly medication reminders that were either simple reminders, or a reminder with an encouraging message | No | Participants were provided with a Nokia phone, as only 48% had access to a cell phone | RCT (in five arms) | HIV patients in Kenya over 18 years that had initiated ART less than three months prior to the study (N=431) | Those receiving weekly messages had significantly improved adherence at 48 weeks (53% vs. 40%, p<.05) |
| Lester 2010 (17) | Adherence to HAART regimens; viral suppression | Weekly message from provider asking if the patient had any problems; patients responded that everything was fine or that there was a problem | Yes | Phone calls by providers to patients who texted researchers with a problem | RCT | Patients >18 years old, recruited from three Kenyan clinics, initiating ART, and with access to a mobile phone (N=538) | Intervention group had increased adherence (62% vs. 50%, p=.006), and increased viral suppression (57% vs. 48%, p=.04) |
| da Costa 2012 (18) | Efficacy of SMS reminders for HIV medication adherence | Medication reminders 30 minutes before last required dose 5x per week | No | None | RCT | Brazilian women seeking care for HIV (N=19) | 100% of those in the intervention group remained adherent at 4 months; 84.6% in the control group remained adherent at 4 months (p>.2) |
| Ammassari 2011 (19) | Primary: Change in self-reported adherence; Secondary: Virologic outcomes | Timed reminders to improve ART adherence and virologic outcomes | No | None | Uncontrolled trial | Suboptimally adherent HIV-infected adults in Italy (N=145) | Participants had improved viral suppression self-reported adherence p<.01 |
| Harris 2010 (20) | Adherence to Haart regimens | Between one and eight daily medication reminders, and weekly question about adherence | Yes | None | Uncontrolled trial | Patients in Seattle starting a new HAART regimen or changing at least two medications (N=224) | Pager reported 90.3% 3-day adherence; 53.6% MEMS (bottle capable of recording opening) adherence |
| **Vitamin Adherence** | Cocosila 2009 (21) | Text message to increase adherence to daily vitamin C pill | Daily text message | Yes | Website on the benefits of vitamin C | RCT | Healthy adults recruited from a university in Canada (N=102) | Greater increase in adherence in the intervention group (2.5 pills missed weekly) versus control (3.3 pills missed weekly), but not significantly powered (p=.54) |

**Table 3: Studies of Text Message Interventions During the Pregnancy Period**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Topic** | **Reference (Author, yr, ref#)** | **Study objective** | **Text message intervention** | **Two-way** | **Other study interventions** | **Study design** | **Target population** | **Findings** |
| **Comprehensive prenatal care health promotion** | Jareethum 2008 (22) | 1) Satisfaction with pregnancy care in those who received prenatal SMS support versus those who did not 2) Pregnancy outcomes in SMS group versus control | Biweekly informational text messages regarding stages of pregnancy | No | None | RCT | Pregnant women in Bangkok at less than 28 weeks gestation, singleton pregnancy, no medical or obstetric complications (N=68) | Satisfaction with prenatal care was 9.25/10 in the intervention group vs. 8/10 in the control group (p<.0001); birth outcomes were not different |
| Kaewkungwal 2010 (23) | Arriving at scheduled prenatal and childhood immunization appointments | Appointment reminders to families | No | Health information sent to healthcare workers' smartphones | Ecological study | Pregnant women and mothers along the Thai/Myanmar border (N=280) | Women were 2.97 times more likely to receive antenatal care at the scheduled time, and children were 1.48 times more likely to arrive at scheduled immunization dates (p<.05) |
| Evans 2012 (24) | Bivariate pre-post comparison of 8 beliefs about prenatal health | Three educational messages sent weekly to new pregnant women | No | None | RCT | Pregnant women recruited from the Fairfax, VA health department (N=123) | Text4baby participants were more likely to agree with the statement “I am prepared to be a mother” (p=.042); All other differences were insignificant |
| **Clinic attendance** | Chen 2008 (25) | Effect on clinic attendance of SMS and phone call reminders and cost-effectiveness of reminders | SMS appointment reminder | No | Phone call reminder | RCT (in three arms) | Attendees at a health promotion center in China (N=1859) | SMS and phone call groups had higher odds of attendance (1.698 and 1.829, respectively, p<.01); SMS was more cost-effective |
| Leong 2007 (26) | 1) Improved attendance rates at primary care clinics; 2) Cost-effectiveness of interventions | Appointment reminders 24-48 hours before scheduled appointment | No | Phone call reminder to third group | RCT (in three arms) | Patients with follow-up appointments at one of seven primary care centers in Malaysia (N=993) | Participants in both the text message and phone call reminder group were significantly more likely to attend their follow-up appointments (OR of 1.59 and 1.55, respectively, p<.01); Text messaging was more cost-effective |
| Fairhurst 2008 (27) | Reduction in missed primary care appointments | Appointment reminders sent approximately twelve hours before the appointment | No | None | RCT | Patients in Scottland who had failed to appear at two or more appointments in the previous year (N=415) | 5% reduction in missed appointments, which did not reach statistical significance (p=.13) |
| Nelson 2011 (28) | Reduction in missed dental care appointments at a pediatric clinic | Appointment reminder 48 hours before scheduled appointment | No | Comparison: voicemail reminder 48 hours before scheduled appointment | RCT | Parents of children at a pediatric dental clinic (N=318) | Those who received text message reminders were 2.42 times as likely to miss their appointment as those who received voicemail reminders (17.7% no show rate versus 8.2% no show rate, p=.011) |
| Prasad 2012 (29) | Reduction in missed dental care appointments | Text message reminder 24 hours before scheduled appointment | No | None | RCT | Patients at an Indian dental clinic who had provided a cell phone contact number (N=206) | Attendance rate was 79.2% in the intervention group vs. 35.5% in the control group (p<.05) |
| Taylor 2012 (30) | Reduction in non-attendance at a physical therapy clinic | Appointment reminder 2-3 days before the scheduled appointment | No | None | RCT | Patients with a scheduled appointment at a physical therapy clinic (N=679) | Patients in the intervention group were less likely to miss their appointment than the control grop (16% vs. 11%, p<.05) and had no significant difference in cancellation rates |
| Downer 2005 (31) | Efficacy of appointment reminders | Appointment reminders sent three working days before scheduled appointment | No | None | Historical case control | Patients who had scheduled an appointment in August 2004 and September 2004 (N=22658) | 9% decrease overall in no-show rate (no p-value) |
| Geraghty 2011 (32) | Reduction in missed ENT appointments | Reminder sent three days before the appointment | No | None | Historical case control | Patients in an Irish ENT clinic (N=8966) | 10% reduction in missed appointments, p=.0001 |
| Sims 2012 (33) | Reduction in missed psychiatric appointments | Messages sent five to seven days before the scheduled appointment | No | None | Ecological study | Appointments at four community mental health clinics in the UK between 2008 and 2010 (N=2817) | Comparing months of different years, there were significantly less missed appointments in the intervention years, 2009 and 2010, than in the historical control year, 2008 (27 and 26% vs. 36%, p<.01) |
| da Costa 2010 (34) | Impact of SMS reminders on outpatient clinic attendance | Appointment reminders | No | None | Ecological study | Wealthy Brazilian patients at private clinics (Number of appointments=7890) | 6.15% reduction in non-attendance |
| **Smoking cessation** | Naughton 2012 (35) | Smoking cessation | 80 messages sent over 11 weeks tailored to baseline questionnaire (0-2 messages a day) | Yes | Leaflet about quitting sent to both groups | RCT | Pregnant smokers identified by midwives in UK communty clinics (N=207) | No difference in smoking rates at twelve weeks (22% vs. 19.6%, p>.05), but intervention group was slightly more likely to set a quit date (44.8% vs. 30.4%, p<.05) |
| Haug 2009 (36) | Smoking cessation | One or three educational messages a week for three months | Yes | SMS craving helpline | RCT (in three arms) | Smokers recruited from a university cafeteria in Germany (N=174) | No significant difference in smoking habits between the control group or two intervention arms |
| Rodgers 2005 (37) | Primary: Smoking cessation at six weeksSecondary: Smoking cessation at 26 weeks | Five educational or motivational messages a day for the first month, then three per week for 6 months vs. one thank you message every 2 weeks in control | Yes | Quitline and nicotine gum subsidies offered to all participants | RCT | Daily smokers in New Zealand who desired to quit, at least 16 years old, and were able to receive text messages on their phones (N=1705) | Intervention group was 2.2 times more likely to quit at 6 weeks (28% vs. 13%, P<.01), but this leveled off at 26 weeks |
| Free 2011 (38) | Biochemically verified self-reported abstinence from smoking at six months | Five motivational and behavior change messages a day for five weeks, and three messages a week for 26 weeks (31 weeks total) | Yes | Messages encouraged participants to call the QUIT helpline | RCT | Smokers >16 years old recruited in the UK via public advertising campaign (N=5800) | Intervention group was 2.2 times more likely to be continuously abstinent for six months, according to self-reported abstinence and verified by salivary cotinine levels (10.7 vs. 4.9%, p<.0001) |
| Obermayer 2004 (39) | Smoking cessation at 6 weeks | At least two messages a day based on high craving times; respondents could request additional support | Yes | Website that logs number of cigarettes smoked and all messages received | Pilot study | College students ages 18-25 who smoke a minimum of 28 cigarettes a week with a desire to quit in the next 30 days | 22% quit for at least seven days (no comparison group) |
| Abroms 2012 (40) | Acceptablity of a 4 week text message supported program for quitting smoking | Text messages three months after participant's quit date, tailored to individual's survey answers to reasons for quitting (0-4 a day) | Yes | Emails and online tracking of progress | Pilot study | University students (N=23) | 82.3% rated the program positively at 4 weeks |
| **Substance abuse** | Suffoletto 2012 (41) | Decrease in maximum drinks per day and heavy drinking weeks | Weekly text message that asked for the total days that they drank in the previous week and maximum drinks in one sitting only (assessment group), or asked for these measures and provided appropriate feedback (intervention), sent over four weeks | Yes | None | RCT (in three arms) | Adults aged 18-24 identified in an emergency department as hazardous drinkers without a current psychiatric disorder (N=45) | Intervention group experienced a small decrease in heavy drinking days in the four weeks and maximum drinks per week (-3.4 and -2.1) while the assessment group experienced an increase (1.8 and 1.1) and the control experienced a small decrease (-1.1 and -0.6). None of these reached statistical significance |
| **Diabetes** | Perez-Ferre 2010 (42) | Comparison of control of gestational diabetes control in standard of care group vs. telemedicine group (as measured by A1c, blood pressure, albumin to creatinine ratio, and weight) | Participants texted weekly glucose measures to their physician, who was able to respond with recommendations | Yes | Chart created mapping glycemic control for the health providers | Partially randomized control trial (8 most severe were allocated to the intervention group) | Pregnant women in Spain diagnosed with gestational diabetes (N=100) | No significant difference in outcomes between the two groups in birth outcomes; Intervention group had an average of 15.05 interactions with health personnel vs. 9.11 in the control group, taking 3.8 hours versus 4.6 hours (p<.001); Insulin dependent women had a significant reduction in the number of clinic visits (82%, p=.03) |
| Kim 2007 (43) | Improved Hgb A1c | Personalized text messages from endocrinology nurse | Yes | Patients recorded glucose readings on a website which input them into their chart | RCT | Patients at a South Korean endocrinology hospital with uncontrolled type 2 diabetes without complications (N=60 randomized, N=51 analyzed) | Mean decrease of 1.15 in the Hgb A1c in the intervention group; mean increase in Hgb A1c of .07 in the control group (p<.05) |
| Mulvaney 2012 (44) | Improved Hgb A1c control | 8-12 messages a week over 6 months tailored to baseline questionnaire about adherence, customized by participants | Yes | Website with messages that users could customize | Pilot study | Teenagers aged 13-17 with type 1 diabetes and historical controls matched on age, gender, and Hgb A1c (N=56) | Mean Hgb A1c at three months in the intervention group was the same as baseline Hgb A1c (8.8%), but historical controls had an increase in A1c to 9.9% (p=.006) |

**Table 4: Studies of Text Message Interventions During Postpartum and Infancy Periods**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Topic** | **Reference (Author, yr, ref#)** | **Study objective** | **Text message intervention** | **Two-way** | **Other study interventions** | **Study design** | **Target population** | **Findings** |
| **Weight loss and activity** | Donaldson 2011 (45) | Reduction in BMI and waist circumference | Participants texted their weight to practitioners twice weekly and received feedback over a 12 week period | Yes | None | RCT | Adults who had completed a weight loss program (N=34) | Intervention group had a decrease in BMI and waist circumference while the control group experienced an increase (difference of 3.7 and 1.5, respectively, p<.05)  |
| Haapala 2009 (46) | Weight loss | Daily tailored text messages with goals, step-wise calorie reduction; participants responded with daily weight for 12 weeks | Yes | Part of a private mobile platform called Weight Balance with individualized recomendations | RCT | Overweight adults ages 25-44 in Finland (N=125) | 4.5 kg weight loss in the intervention group; non-significant change in weight loss in the control group (p=.0001) |
| Patrick 2009 (47) | Weight loss | 3-5 messages daily tailored to time of day, baseline questionnaire, and participant's previous replies for 12 weeks | Yes | Website that tracked weight; Monthly phone calls with counsellors eliciting feedback on the program | RCT | Community members aged 25-55 with BMI 25-39.99 (N=65) | After adjusting for time, sex, and mean age, intervention group lost 1.97 kg at 4 months (p=.02) |
| Prestwich 2010 (48) | Increase in walking a minimum of 30 minutes 3x a week  | Reminder created by each participant to walk, sent an average of 3.7 times a week; An average of 5.1 texts per week for four weeks | No (but customized throughout the study) | None | RCT | Adults in Leeds, UK recruited via email that exercised less than 3 times a week, did not have a medical condition, and were able to receive text messages (N=149) | The text message intervention groups increased the number of days that they met daily recommended exercise by half a day a week (p<.05) |
| Sirriyeh 2010 (49) | Increased physical activity amongst adolescents | Affective or instrumental messages prompting physical activity sent daily for two weeks | No | None | RCT | Students 16-18 years old in a Leeds, UK school (N=128) | Participants increased their activity an average of 31.5 minutes a week; A post-hoc analysis revealed that inactive participants who received affective messages had the greatest increase in physical activity (p=.018); Other groups were not significantly different |
| **Depression** | Whittaker 2012 (50) | Satisfaction with a text message based depression intervention | Twice daily text messages based on cognitive behavioral therapy techniques vs. general health promotion messages for 9 weeks | No | Access to mobile website | RCT | Students in five New Zealand high schools, aged 13-17 (N=1348) | Those in the intervention group thought it helped them to be more positive (66.7% vs. 50.1% in the control, p<.001) and get rid of negative thoughts (50.2% vs. 32.4% p<.001) |
| **Vaccination rates** | Kharbanda 2011 (51) | Pregnant women's views on vaccination | Informational messages regarding flu vaccine in pregnancy | NA | None | Focus group | Pregnant women in New York City (N=40) | Only half had received influenza vaccine in the previous year. Overall felt that text message would them talk with their provider |
| Ahlers-Schmidt 2012 (52) | Effect size of text message immunization reminders on infant immunization schedule adherence | Immunization reminders | No | None | RCT | Low income Spanish and English-speaking parents of newborns discharged from a university hospital (N=90) | No significant difference in adherence to childhood immunization schedule; 40% of participants experienced a disruption in phone service |
| Stockwell 2012 (53) | Increased influenza vaccination | Five weekly text messages in English and Spanish regarding the safety and efficacy of the vaccine (3), and the time and location of vaccination clinics (2) | No | None | RCT | Parents in four low-income pediatric clnics in New York (N=7574 analyzed) | The intervention group was marginally more likely to receive the influenza vaccine (43.1% vs. 39.2%, p<.05) |
| Kharbanda 2011 (54) | Higher vaccination rates within the scheduled window for second and third HPV vaccine dose | Three weekly reminders about the second and third vaccine to parents who enrolled | No | None | Cohort study | Parents of girls ages 9-20 at five pediatric clinics due for the second and third HPV vaccine (N=432) | 51.6% of those enrolled in the text message intervention received a second HPV vaccine within the recommended window, versus 35.0% of those who were not (p<.001), comparable to historical control (38.1%) |