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SMS PARENT ACTION INTERVENTION (SPAN): A PILOT STUDY TO ASSESS THE

FEASIBILITY OF USING TEXT MESSAGING TO PROMOTE CHILD HEALTH ON

AN AMERICAN INDIAN RESERVATION

By

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SMS Parent Action iNtervention (SPAN): A pilot study to assess the feasibility of using text messaging to promote child health on an American Indian Reservation

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Abstract

 Purpose: Childhood obesity and its associated health risks are widely recognized as a major public health crisis in the United States (Johnson & Johnson, 2014; Proctor, 2008; Rogers et al, 2013; Vinci et al, 2016) and worldwide (Elías-Boneta, Toro, Garcia, Torres, & Palacios, 2015). Among children in low-income families, American Indian/Alaska Native (AIAN) children have the highest prevalence of obesity (21.1%) compared to other racial/ethnic groups (14.74% overall) (Pan et al, 2015). Parents play an important role in introducing healthy foods and encouraging physical activity in young children (Birch & Ventura, 2009; Lindsay et al., 2006; Natale et al., 2014). Text messaging is an attractive means of communication because it is portable, cost-effective, accessible, and able to reach across demographic spheres to serve underserved and rural populations (Terry, 2008), and populations with poor health (Fjeldsoe, Marshall, & Miller, 2009). The primary purpose of this pilot study was to assess the feasibility of the SMS (Short Messaging System or text messaging) Parent Action iNtervention (SPAN) obesity prevention intervention for rural white and AI children.

 Methods: This 5-week quasi-experimental pre- to posttest pilot study took place on a rural, American Indian (AI) Reservation. Participants were parents whose children were 3 to 5 years old. The intervention consisted of participants receiving three text messages on a particular topic each week that described health behaviors to reduce risk of childhood obesity. The topics included childhood nutrition, physical activity and sleep requirements, and recommendations for limiting screen time and sugary beverage consumption. The main study measures were descriptions of study feasibility (recruitment and retention rates, receipt and response to text messages, satisfaction with message content, timing, frequency, and duration). We also collected information on pre- to posttest changes in participant knowledge/desires for their children related to healthy behaviors and parent-reported child behaviors.

 Results: Over 8 weeks, 24 parents of young children expressed interest in participating in the study; following screening, 71% (17/24) met eligibility criteria and were consented to the study. At the end of the 5-week intervention, 100% (17/17) completed the texting intervention and final assessments. All intervention texts (n=289) sent to participants were successfully delivered. Of the 85 survey question texts that requested a response, 95% (81/85) were responded to with any answer, while 91% (78/85) were responded to by answering the survey question. All participants (17/17) reported they found the texts easy to understand and they liked the timing - what time of day they received the messages. Ninety-four percent (16/17) of participants reported enjoying the frequency (3 per week) with which they received messages, and participants either reported 5 weeks was a good amount of time or too short. At the end of the 5-week intervention, improvements were observed in some of the child behaviors.

Conclusion: Findings suggest it is feasible to deliver a text messaging-based childhood obesity prevention intervention to parents living on a rural, AI Reservation. Text messages were well received by parents of young children and texting parents may influence child behavior. Our study targets gaps in the literature and helps guide future research using text messaging to promote child health and prevent obesity.

Chapter One: Introduction

Childhood obesity has been characterized as a multisystem disease with potentially devastating consequences in adulthood including increased risk for type 2 diabetes, hypertension, asthma and some types of cancer (Johnson & Johnson, 2014; Proctor, 2008; Wofford, 2008). Childhood obesity can result in decreased self-esteem, depression, and other psychological impacts (Proctor, 2008; Wofford, 2008). Children living in rural areas have increased odds of becoming obese, compared with those living in urban areas (Johnson & Johnson, 2014). the United states, 54% of AIAN people live in rural and small-town areas, and 68% live on or near their tribal homelands (Dewees & Marks, 2017). Among children in low-income families, American Indian/Alaska Native (AIAN) children have the highest prevalence of obesity (21.1%) compared to other racial/ethnic groups (Pan et al, 2015). While the prevalence of childhood obesity has decreased for other racial/ethnic groups in recent years, it has risen for AIAN children (Pan et al., 2015).

As a multifactorial problem, childhood obesity requires complex solutions. Childhood obesity prevention methods must take into account parent and caregiver's (PAC) roles as agents of behavior change for reducing risk of obesity in their children, and focus on promoting evidence-based prevention strategies. Text messaging is a cost effective communication tool that is easily expandable to rural communities. It is a feasible and acceptable intervention medium for sending and receiving messages related to diet and exercise (Shaw & Bosworth, 2012).

There has been minimal research conducted to determine the feasibility of interventions that include text messaging parents of young children living in rural, AI Reservation communities with information on the topic of overweight/obesity prevention methods.

Purpose of the Study

The primary purpose of the study was to assess the feasibility of a childhood obesity prevention texting intervention for parents of young children living on or near an American Indian Reservation in a rural setting. Study feasibility was determined by looking at recruitment and retention rates, receipt and response to text messages, participant satisfaction with message content, timing, frequency, and duration of text messages, and participant input on the intervention. The study also has two secondary aims: 1) assess the effect of text messages on parents' understanding about healthy child behaviors regarding sleep, fruit and vegetable consumption, screen time, physical activity and sugary beverages, and 2) investigate whether parents receiving texts about healthy child behavior will lead to behavior change of the child in these salient behaviors.

Statement of the Problem

There is a strong rationale for understanding the feasibility of a text messaging intervention for preventing overweight/obesity in young children. Minimal studies have been done to explore the feasibility of texting parents about healthy behaviors in their children. Previous studies are limited by small sample sizes and the use of focus groups to determine feasibility instead of conducting actual texting interventions. To our knowledge, there are no reports in the literature exploring the feasibility of implementing a text messaging based childhood obesity prevention intervention that includes collecting health behavior related outcomes.

This study will add to the paucity of research in this area and may help guide future childhood obesity prevention interventions that include text messaging to parents living on or near an American Indian Reservation.

Research Questions

This study will explore the following research questions through a quasi-experimental research design:

1. Is it feasible to implement a text messaging childhood obesity prevention intervention for parents of young children living on or near an American Indian Reservation in a rural setting?

Feasibility is defined as "the ability to transmit data via SMS to participants, the receipt of information by participants and the ability to communicate back to the researchers" (Shaw and Bosworth, 2012). This will be determined by collecting data on recruitment and retention and how many participants received and responded to messages.

   i) Information will also be collected during post-test surveys about participants' preferred frequency, duration and timing of text messages, message clarity and content value, and participant input on the intervention as a whole.

2. Can text messages increase parental understanding of child behaviors in the health behavior domains of sleep, fruit and vegetable consumption, screen time, physical activity and sugary beverages?

This will be determined by assessing pre- and post-test survey responses about what the parent believes are healthy behaviors in these five domains for their children.

3. Will sending 3 weekly texts about healthy child behavior will lead to behavior change of the child in these five domains (i.e., sleep, fruit and vegetable consumption, screen time, physical activity and sugary beverages)?

This will be determined by assessing pre- and post-test survey responses on parent reported child behaviors in these 5 domains, as well as parent reports in weekly text survey responses.

Delimitations

1. The study will be delimited to parents of children, age 3 – 5 years old living on or near an American Indian Reservation. Parents of children in this age range will be recruited to the study from Head Start centers and a medical facility on the Reservation.

2. The data will be restricted to self-report responses on the questionnaires.

3. The study will be delimited by voluntary participation.

Limitations

1. The data will be limited to parents of children aged 3-5 from the target population who volunteered to participate in questionnaires and text messaging. These study participants may have different understanding of healthy child behaviors, motivation or comfort texting than those who did not participate in the study.

2. The responses elicited will be limited to the accuracy of the participants during the completion of the questionnaires.

3. The generalizability of the results will be limited due to only sampling parents living on or near one AI Reservation in a rural setting.

Definition of terms

10-5-2-1-0: Derived from the Let's Go! 5-2-1-0 campaign, which advocates that children should eat at least five servings of fruits and vegetables daily, spend two or fewer hours watching television or doing recreational screen activities (such as video games) each day, strive for at least one hour of moderate physical activity daily, and avoid all sugary beverages, including fruit juices (zero sugary drinks). We have adapted this campaign to add the importance of adequate (at least ten hours) sleep, changing the phrase to 10-5-2-1-0.

AI: American Indian

AIAN: American Indian/Alaska Native

Body Mass Index (BMI): Defined by the Centers for Disease Control and Prevention (CDC, 2015), "Body Mass Index (BMI) is a person's weight in kilograms divided by the square of height in meters. A high BMI can be an indicator of high body fatness. BMI can be used to screen for weight categories that may lead to health problems but it is not diagnostic of the body fatness or health of an individual."

CT: Cognitive theory (or SCT - Social Cognitive Theory)

PA: Physical activity

PACs: Parents and caregivers

SMS: Short Messaging Service, also referred to as text messaging

Text message intervention feasibility: "The ability to transmit data via SMS to participants, the receipt of information by participants and the ability to communicate back to the researchers." (Shaw and Bosworth, 2012) Expanded here to include: participants' preferred frequency, duration and timing of text messages, message clarity and content value, and participant input on the intervention as a whole.

Chapter Two: Review of Literature

INTRODUCTION

This literature review aims to understand the health risks of childhood obesity and factors that influence obesity on individual, family, environmental and societal levels. Prevention methods will be discussed as will disparities in obesity across racial/ethnic and socio-economic lines as found in the literature. The role of parents as agents of behavior change will also be explored.

In order to understand the use of text messaging in research, this review will examine the literature on using the technology within an intervention. Feasibility of implementing a texting intervention for preventing childhood obesity and use of texting in healthcare settings will be explored. Healthcare applications of text message interventions include behavior change, smoking cessation, appointment reminders, and overweight/obesity. Taking into account the large influence parents and caregivers (PACs) have on their children and the wide use of text messaging in health care, this review concludes with a look into research conducted on texting PACs directly as a way to influence their child's behavior, eating habits and BMI status.

CHILDHOOD OBESITY

Childhood obesity and its associated health risks are widely recognized as a major public health crisis in the United States (Johnson & Johnson, 2014; Proctor, 2008; Rogers et al, 2013; Vinci et al, 2016). To determine if a child is underweight, normal weight, overweight or obese, body mass index (BMI)-for-age percentiles are used (CDC, 2015). Obese children are defined as those who have a "BMI at or above the gender and age specific 95th percentile BMI cut off points from the 2000 CDC growth charts" (Castro, 2013). Recent data on children in the U.S. shows obesity rates of 9.4% for 2 to 5 year olds, 17.4% for children aged 6 to 11 and 20.6% for

children aged 12 to 19 years (Ogden et al., 2016). The situation is similar in Montana, where 9.4% of adolescents are obese and 11.3% of 2 to 4 year olds whose parents participate in the WIC program are obese (CDC, 2015).

Childhood obesity has been characterized as a multisystem disease with potentially devastating consequences in adulthood including increased risk for type 2 diabetes, hypertension, asthma and some types of cancer (Johnson & Johnson, 2014; Proctor, 2008; Wofford, 2008). Childhood obesity can result in decreased self-esteem, depression, and other psychological impacts (Proctor, 2008; Wofford, 2008).

Simply stated, obesity results from a positive energy balance (more energy intake than expenditure), however many individual and societal factors also influence the childhood obesity epidemic (Castro et al., 2013; Wofford, 2008). Touted in life course theory, research suggests that early childhood and preschool years are a 'critical period' when the risk for childhood obesity is higher and thus, prevention is exceedingly necessary (Castro et al., 2013; Wofford, 2008). There are correlations between physical activity, television viewing and childhood obesity. For example, there is a decreased risk of obesity with each hour per day of moderate-to-vigorous physical activity or participation in sports, and an increased risk of obesity for each hour per day of television viewing (Singh et al., 2008).

Several environmental and societal factors also contribute to childhood obesity. Sedentary lifestyle behaviors that are associated with increased risk of childhood obesity include increased use of cars for transportation, less time for physical activity in schools, fewer outdoor recreational areas/parks and less access to existing outdoor areas (Proctor, 2008; Wofford, 2008).

Racial/Ethnic Disparities

7

Although obese children are present across all demographics, research has shown discrepancies among racial, ethnic and socio-economic divisions (Johnson & Johnson, 2014; Ogden et al., 2016). The odds of obesity for children and adolescents are higher among non-Hispanic black (19.5%) and Hispanic populations (21.9%) than non-Hispanic white (14.7%) and non-Hispanic Asian populations (8.6%) (Ogden et al., 2016). Among children in low-income families, American Indian/Alaska Native (AIAN) children have the highest prevalence of obesity (21.1%) compared to other racial/ethnic groups (Pan et al, 2015). While the prevalence of childhood obesity has decreased for other racial/ethnic groups in recent years, it has risen for AIAN children (Pan et al., 2015).

In Montana, 89.4% of residents identify as white, 6.3% as AIAN, 1.8% as other races, and 2.5% as belonging to two or more races (US Census Bureau, 2010). Age-adjusted mortality rates are statistically significantly higher for AIAN's than for white Montanans (MT DPHHS). Nearly 19% of AIAN adults reported living with diabetes in 2005, a number two and a half times higher than for the general Montana population (Hall et al., 2008). American Indian/Alaska Native residents of Montana have higher incidence rates of lung cancer, colorectal, kidney, and liver cancers than white residents (MT DPHHS). In Montana, 38.7% of the AIAN adult population is obese (BMI between 30.0 - 99.8), which is high compared to 22.7%, 31.2% and 22.1% for white, multi-racial and Hispanic Montanans, respectively, and 29.8% national adult obesity rates (CDC, 2015_4).

Rural Populations

Children living in rural areas have increased odds of becoming obese, compared with those living in urban areas (Johnson & Johnson, 2014). More than half (53%) of Montana's residents live in rural or frontier areas that lack essential services such as health care, and most of

Montana's counties are designated as medically underserved (MT DPHHS). All seven of Montana's Reservations are in rural areas, which often have limited access to stores that stock affordable, fresh, healthy food. Food insecurity leads to difficult choices such as skipping meals, and often results in reduced quality of nutrition which can lead to obesity (Burhop, 2016). In 2016, 61% of adults living on Montana Reservations skipped meals or reduced portion sizes due to lack of food (Burhop, 2016).

Prevention

Since children who are overweight or obese are more likely to be obese as adults, obesity prevention efforts early in life can help children avoid lifelong health issues and their associated costs (Segal et al., 2016). An association between early adiposity rebound and obesity in later years suggests the preschool years are a critical period for obesity prevention, especially for children under 4 years old (Wofford, 2008; Segal et al., 2016; Singh et al., 2008). Prevention strategies with a focus on promoting healthy behaviors, such as increased intake of fruits and vegetables, were found to be more effective than those focused on limiting unhealthy behaviors such as decreasing fat or sugar intake (Wofford, 2008). Parents play an important role in introducing healthy foods and encouraging physical activity in young children (Birch & Ventura, 2009; Lindsay et al., 2006; Natale et al., 2014). Other adults who also have a long term relationship with children, such as pediatricians, can also work to prevent childhood obesity by promoting increased fruit and vegetable consumption, at least 60 minutes of daily physical activity, and reduced sugary beverage consumption, among other things (Daniels & Hassink, 2015).

Let's Go! 5-2-1-0

Let's Go! 5-2-1-0 is a multi-setting community-based approach to improve healthy eating and physical activity, the underlying health behaviors that have been demonstrated to impact overweight and obesity (Rogers et al., 2013). The program was created by the United Way and several community partners in Portland, Maine in 2006. The two primary aims of Let's Go! 5-2-1-0 are to deploy a simple message about healthy choices across multiple community settings, and to implement environmental and policy changes that will support families making healthy choices where they live, work and play (Rogers et al., 2013). The mnemonic, 5-2-1-0, represents four recommendations for healthy living. Each day, children should eat at least five servings of fruits and vegetables, spend two or fewer hours watching television or doing recreational screen activities (such as video games), strive for at least one hour of moderate physical activity, and avoid all sugary beverages, including fruit juices (zero sugary drinks) (Rogers et al., 2013; Vinci et al., 2016).

After nine years of program implementation in Maine and adaptation by communities in other states, Let's Go! 5-2-1-0 has shown that it is feasible for a community to implement an appealing and memorable multi-year branding campaign aimed at behavior change (Rogers et al., 2013; Vinci et al., 2016). The program successfully increased children's consumption of fruits and vegetables, decreased children's intake of sugary drinks, and increased parent awareness of the program (Rogers et al., 2013; Vinci et al., 2016). The Let's Go! 5-2-1-0 model for community based educational programs has been successfully adapted for use by communities attempting to maintain or lower childhood obesity levels (Santa Cruz County 5210+ program).

The Let's Go! 5-2-1-0 program is an appropriate model for use with a text messaging intervention, as it provides clear and concise guidelines that are easily transferable to a short message system (SMS) format with limited character allowances. To my knowledge, there are no studies reported in the literature that adapted the Let's Go! 5-2-1-0 program to be delivered through text messages to parents to prevent obesity in their children.

PARENTS AS AGENTS OF BEHAVIOR CHANGE

Childhood obesity prevention methods should take into account parent and caregiver's (PACs) roles as agents of behavior change for overweight/obese children. Several studies have examined the relationship between PACs behaviors and children's eating habits, PA and weight status. One study found significant improvement in child behaviors that support healthy weight after parents of low income children (aged 3-11) attended eight weekly 90 minute classes focused on nutritional and PA behavioral objectives (Lent et al., 2012). The child behaviors that supported healthy weight included drinking water or milk instead of sweetened drinks, eating more vegetables and fruits, limiting high-fat and high-sugar foods, playing actively, limiting TV and computer time, and having sensible servings (Lent et al., 2012).

Interventions that focus on helping parents improve their diet may also influence diet changes among adolescents. In a study by Watts and colleagues, parent and adolescent (age 11-16 years) dyads participated in an 8-month, web-based, lifestyle modification intervention cross-sectional study (2014). Adolescents were overweight or obese before the start of the study. Parent and adolescent participants tracked their daily dietary intake, then comparisons were made between the two groups. Parental dietary intake of fruits and vegetables, total fat, saturated fat, sugar, sugar sweetened beverages and snacks were found to be positively associated with

adolescent intake (Watts et al, 2014), meaning the more the parents ate, the more their adolescent child ate.

Mazzeo et al. (2014) found that, compared with a control group, racially diverse families (61% African American) who completed a 6-12 week culturally sensitive parenting intervention called Nourishing our Understanding of Role Modeling to Improve Support and Health (NOURISH) significantly improved BMI in their overweight children (aged 6-11). NOURISH participants reported high satisfaction levels with the course and the majority (91%) strongly or moderately agreed that the program helped them eat in a healthier manner (Mazzeo et al., 2014). Taken together, these studies suggest PACs can be successful agents of behavior change for children. However, the majority of previous studies involve treatment of overweight/obesity in older children (5 and older) rather than prevention in younger children (age 3-5). Future research should investigate how to incorporate PAC influence in early childhood prevention efforts, especially in rural areas and for medically underserved and low income populations.

TEXTING INTERVENTIONS

Text messaging, also referred to as short message service (SMS) messaging, is an increasingly popular form of communication around the world. According to a 2012 Pew Research Center report, 85% of the American adult population use cell phones, and 80% of these adults regularly send or receive text messages (Duggan & Rainie, 2012). Adult cell phone use has risen from 58% in 2007, showing a steady increase in usage over time. While still uncommon in elderly Americans (34%), texting is nearly universal for 18-29 year olds, 97% of whom text regularly, and 30-49 year olds, 92% of whom use their cell phone for texting (Duggan & Rainie, 2012).

Rural adults remain less likely than urban and suburban adults to have and use broadband internet and smart phones, despite recent gains in digital technology adoption (Perrin, 2017). For example, rural Americans (67%) are 10 percentage points less likely than those in urban areas (77%) to report having a smartphone. In Montana, many AI Reservations have irregular cell phone service, leading some to partner with telecommunications companies to build cell phone towers and infrastructure (Caufield, 2015). Text messaging is an attractive means of communication because it is portable, cheap, accessible, and able to reach across demographic spheres to serve underserved and rural populations (Terry, 2008), if the technology is available in these areas.

Text Messaging Feasibility

Since cellular phones are already an integral part of many people's lives, there is vast potential for using text messaging as part of research interventions (Head et al., 2013). In addition to being a popular means of communication, text messaging has been shown to be feasible, acceptable (Shaw & Bosworth, 2012) and applicable as an intervention tool for adolescents and parents (Pattishall, Ellen, & Spector, 2013). Text messaging feasibility is defined as "the ability to transmit data via SMS to participants, the receipt of information by participants and the ability to communicate back to the researchers" (Shaw and Bosworth, 2012). A study conducted in the United Kingdom found that using an automated SMS system to measure change in depression is feasible, acceptable and inexpensive, and that participants enjoyed receiving and responding to text messages (Richmond et al., 2015). Text messages allow researchers to monitor changes in mood and plot changes more frequently than with traditional data collection methods (Iribarren et al., 2013). In a 2013 study, Irribarren and colleagues showed texting was a feasible and acceptable intervention option for patients with tuberculosis (TB). Further, the

messaging intervention was found to have a low refusal rate, and most participants had access to mobile phones and knowledge on using the SMS feature (Iribarren et al, 2013).

Additionally, text messages promoting healthy lifestyle choices have been shown to be an acceptable means of communication for teens who already have mobile phones and plans that include unlimited text messages (Hingle et al., 2013). A 2015 review of the literature on using text messaging for maternal and child health found that text messages are applicable to promoting healthy behaviors, especially for underserved populations (Poorman et al., 2015). Similarly, results of a 2013 meta-analysis by Head and colleagues revealed that text messaging based health promotion interventions are generally efficacious (d = .329, showing a small to medium effect size), and they show "considerable promise" for improving a range of health outcomes and behaviors.

Text Message Intervention Moderators

Spohr and colleagues (2015) conducted a meta-analysis on the effectiveness of texting interventions for smoking cessation. These investigators identified several variables, or intervention moderators, that are commonly used in texting interventions. Commonly used moderators and research findings on their use are as follow:

1) **Intervention Type – SMS only or SMS plus**

    SMS only refers to interventions that limit their communication to text messages. SMS plus includes in-person or web support, such as counseling sessions, or links to outside sources such as websites, videos or other media.

A meta-analysis found that SMS plus interventions were not significantly better than text only interventions (Spohr et al., 2015), mirroring results found by Head and colleagues (2013).

2) **Message frequency**

How often study participants receive text messages plays a critical role in intervention effectiveness. Messages can be sent on a decreasing schedule, fixed schedule or variable schedule. For example, someone receiving texts on a decreasing schedule would expect more texts in the beginning of the intervention than in the end. A fixed schedule indicates the number of texts sent will remain constant throughout the intervention. A variable schedule signifies that text recipients are able to change the frequency of text messages as they see fit.

Message frequency, content and wording are important aspects that have been shown to moderate intervention effectiveness (Head et al., 2013; Pattishall et al., 2013). The most successful interventions seem to be those that allow participants to personalize when and how often they receive messages and those whose message frequency decreases over the course over the study (Head et al., 2013). In one intervention that involved texting children directly, disengagement and lack of interest occurred after children were asked to self-monitor for more than 6 weeks (Silva et al., 2015). Strategies for keeping children engaged include decreasing message frequency over time, and sending motivational messages towards the end of the intervention (Silva et al., 2015). Varied message timing and content also contributes to increased engagement and fewer ignored messages (Poorman et al., 2015).

3) **Message tailoring, targeting or both**

Tailored messages are customized specifically for the individual recipient based on personal characteristics and usually include his or her name. For a smoking cessation

intervention, messages may be tailored according to the recipient's quit status or intended quit date. Targeted messages are customized based on shared demographic characteristics of the group, such as gender, ethnicity or location. Messages that include targeting and tailoring are customized based on shared demographic characteristics as well as individual characteristics of participants.

Head et al. found message tailoring and personalization to be significantly associated with greater text message intervention efficacy (2013). Studies that used only tailoring showed similar efficacy levels similar to those that used a combination of tailoring and targeting (Spohr et al., 2015). No studies were identified that didn't use any tailoring *or* targeting, making it difficult to determine the effect of these kinds of interventions (Spohr et al., 2015).

4) Bi-directional messaging and assessment messages

Assessment messages are sent from the participant to the researchers in response to a specific question. For example, if the participant received a text asking how many cigarettes smoked that day, they could respond with a number. Researchers would then send a reply (typically an automatic response from a pre-set list) based on the number of cigarettes the participant had smoked.

The impact of bidirectional messaging is unclear. A meta-analysis exploring the efficacy of text message interventions for smoking cessation done by Spohr and colleagues (2015) found that assessment messages increased quit rates slightly, but not significantly. Poorman et al. (2015) showed that texting interventions that allow two-way messaging and feedback are more successful than those where participants can't reply. Further research is required to identify the components that lead to effective texting interventions (Spohr et al., 2015).

TEXTING IN HEALTHCARE

Although a relatively new phenomenon, text messaging has been used in various fields of healthcare for more than a decade. A systematic review of randomized controlled trials (RCTs) found that the use of text messages increased the likelihood of attendance at clinical appointments by 50%, compared to no reminder, for a variety of age groups (Guy et al., 2012). Similarly, Head et al. (2013) found text messaging technology to be effective for delivery of health messages. In an attempt to determine *why* and *how* text messaging is effective, this section will describe literature that explores the use of texting adults across a wide range of health content areas, including behavior change, smoking cessation, adherence to medication, and overweight/obesity.

Behavior Change

Several recent studies have been conducted to evaluate whether previously determined mechanisms of behavior change transfer to mobile phone applications. Buhi et al (2012) performed a systematic review of literature on mobile phone-based behavioral interventions for health. The review included interventions focused on diabetes management, smoking cessation, weight loss/obesity prevention, asthma self-management, physical activity and other areas. Of the thirty-four interventions reviewed, most resulted in statistically significant health behavior changes (Buhi et al., 2012). While texting interventions have led to improved health outcomes, few include longitudinal studies (Buhi et al., 2012), and studies that implemented stand-alone texting interventions (that don't include in person, telephone, or other communication aspects). Future research should evaluate the effect of text messaging interventions – especially stand-alone texting interventions, on long term behavior change.

Smoking

Smoking cessation, one of the most common aims of text message interventions (Spohr et al., 2015), has been shown to increase after a text messaging intervention (Free et al., 2013). Müssener and colleagues (2016) conducted a single-blind, 2 arm, randomized clinical trial of Nicotine Exit (NEXit) on Swedish college and university students. The NEXit intervention began with a 1- to 4-week motivational phase during which 1590 participants, mostly between the ages of 21 and 30 years, chose a quit date. Participants then received 157 text messages over 12 weeks, with 4 to 5 daily texts in the first week, followed by fewer texts each subsequent week. Participants could also request extra messages as needed for help with cravings, relapse or concerns about weight gain. Texts were created based on existing evidence-based smoking cessation techniques that were already in use in Sweden. Control group participants received one text each fortnight thanking them for participating in the study. The NEXit intervention was found to approximately double the rate of prolonged abstinence from smoking (allowing occasional lapses) after 4 months, with a risk difference of 11.3% (Mussener et al., 2016).

Another smoking cessation text-messaging program, Text2Quit, was also found to increase the likelihood of abstinence (Boschert, 2014). The 6-month randomized, controlled trial included 503 adults who smoked 5 or more daily cigarettes, had unlimited texting on their mobile phones, were already avid text users and were interested in quitting cigarettes. Participants received automated, bi-directional texts and were asked to track their smoking and report on their cravings and smoking status. The highest daily frequency of texts (5 texts) were sent on the participants chosen quit date, after which message frequency declined weekly. At the 6-month follow up, biochemically confirmed abstinence was shown to be 11% in the intervention group and 5% in the control group. Comparable results were found in a 2015 meta-

analysis on the effectiveness of texting interventions for smoking cessation done by Spohr and colleagues. After analyzing 13 RCTs, text messaging intervention groups were found to have 36% higher quit rates than control groups (Spohr et al., 2015).

Medication Adherence

Medication adherence is the extent to which a person follows their medication prescription regimen, and can include timing, frequency, route and dose (DeKoekkoek et al., 2015). An integrative review of 13 articles on using texting to promote medication adherence found adherence rates improved 15.3 – 17.8% with the use of text messages. Due to the range of study types and methods, it is unclear whether success is related to theoretical frameworks, messages being tailored or standardized, or the use of one-way or two-way messages. However, text messages were determined to be a highly satisfactory, easy and effective means of promoting medication adherence across many disease types (DeKoekkoek et al., 2015).

Overweight/Obese

Several studies have looked at the use of text messaging to treat overweight or obese people. Dutch researchers studied the effect of a short message service maintenance treatment (SMSMT) intervention on 141 overweight/obese children (intervention n=73, control n=68) aged 7-12, who were enrolled in a year-long weight loss program in the Netherlands (de Niet et al., 2012). Based on various behavior change methods, the SMSMT intervention primarily used self-monitoring and personalized feedback. Participants were asked to text weekly self-monitoring data on PA, healthy eating patterns, and mood. They were texted one question about each of the three health behaviors, and expected to answer based on a 5 point Likert scale. They then received a tailored feedback message. After 9 months, the intervention wasn't shown to influence BMI, eating behavior, or psychological well-being, but intervention participants were

less likely to withdraw from the weight loss program (de Niet et al., 2012). While it provided some data, the study was limited by asking participants to use a Likert scale (rating on a scale from 1 to 5) to describe complex issues such as PA, healthy eating and levels of sadness. Questionnaires and other evaluation techniques such as focus groups or in-person interviews may provide more insight into health behaviors and mood in future studies.

A 2015 study of 139 Portuguese children aged 8-10 years found that text message monitoring and feedback significantly increased fruit and vegetable consumption (Silva et al., 2015). In this randomized controlled trial, students in the control group (n=70) and the intervention group (n=69) were given a pedometer to wear, completed weight and height measurements, and attended two 60-minute information sessions on fruit and vegetable consumption, physical activity and screen time. Those in the intervention group were also asked to report via text message on the number of daily steps walked, number of fruits and vegetables eaten, and minutes of screen time. One-way automatic text responses were sent, based on the children's reports, to reinforce positive developments and motivate the children. The students could not comment or respond to the messages. Results showed the SMS program was not effective at increasing PA and decreasing screen time, but it did significantly increase fruit and vegetable intake for the intervention group (Silva et al., 2015). These differing behavioral results may be due to the high levels of PA and low levels of screen time children already had at baseline which may have translated into students not having much motivation to change these behaviors during the intervention. Results may also indicate that long periods of self-monitoring messages without variation could lead to disengagement. Further research should include more motivational messages and go beyond repetitive self-monitoring.

As this intervention used text messaging as an additional tool in a broader intervention, it provides limited information about the feasibility of stand-alone text messaging interventions for weight loss promotion. Future research should assess whether and how to use SMS interventions in combination with other intervention methods (Shaw & Bosworth, 2012). The study by Silva and colleagues also presents an interesting dilemma in its use of text messaging in a program that promotes less screen time. Future research should consider texting parents with health information about their children as a way not to provide children with mixed messages about the use of mobile phones and other electronic devices.

TEXTING PACs TO INFLUENCE CHILD'S OVERWEIGHT/OBESITY

Taking into account the large influence PACs have on their children and the wide use of text messaging in health care, this literature review concludes with a look into research conducted on sending text messages to PACs as a way to influence their child's behavior, eating habits and BMI status.

In the Healthy Habits, Healthy Homes (HHHH) intervention, parents of 2 to 5-year-old children participated in a 6-month intervention to promote household routines that help prevent overweight/obesity (Haines et al., 2013). The HHHH intervention promotes eating meals as a family, getting adequate sleep, and limiting screen time. Of the 121 parent-child dyads who participated in the study, the majority had a household income of $20,000 or less, 47% of the children were overweight, and 20% obese. The intervention group (n=62) was encouraged to follow household routines in three ways: 1) motivational coaching with a health educator, 2) mailed educational materials, and 3) weekly text messages. Control group participants (n=59) only received mailed educational materials but did not get motivational coaching or weekly text messages. At baseline, children in the sample were frequently eating meals in front of the

television, sleeping less than the recommended 11-13 hours, and exposed to 2 or more hours of screen time per day. Parents had cell phones, were accustomed to sending and receiving texts, and most enjoyed texting.

After the 6-month intervention, researchers found the treatment group had increased sleep duration, greater decreases in TV viewing on the weekend, and decreased BMI compared to the control group (Haines et al., 2013). No change was found around meal frequency or the presence of a TV in the room where the child slept. These findings show interventions that promote healthy household routines to parents could fill a gap in obesity research. This study's use of mailings and in person-meetings in addition to text messaging makes it difficult to determine the effectiveness of any one educational method. Further research should focus on stand-alone text messaging interventions for parents around promoting healthy household routines for children.

The TEXT2COPE was conducted with 15 parents of overweight/obese children to determine the feasibility, acceptability and preliminary effects of the intervention (Militello, 2014). The seven-week cognitive behavioral therapy (CBT) based skill building program used text messages as triggers to motivate, remind, and facilitate behavior. Skills included knowledge on nutrition and physical activity, problem solving, goal setting, effective communication, positive self-talk, and positive thinking. In addition to clinic visits and homework, three types of text messages were used: 1) tailored and adaptive messages – the participant has control over message content, timing, and frequency, 2) static two-way messages – timing, delivery, and content is constant and determined by the PI, and 3) automated SMS – sent as a response to static messages, from a pre-determined library of texts based on CT (Militello et al., 2016).

Results indicated that a cognitive behavior skills program with text message triggers is both feasible and acceptable with parents of overweight/obese preschool aged children (Militello,

2014). The intervention resulted in significantly increased self-reported healthy lifestyle behavior choices as determined by participant scores on three measures: A 20-item nutrition knowledge questionnaire that measures parental knowledge about nutrition for participants and their families (with questions on portion sizes, nutritional information, health, and eating habits), a 12-item physical activity questionnaire (e.g., exercise can help to prevent diabetes, dancing is exercise, exercise reduces stress), and a healthy lifestyle behaviors scale where participants answer questions such as "I do what is necessary to lead a healthy life and provide a healthy lifestyle for my family" on a 1-5 Likert scale (Militello, 2014). Researchers later analyzed TEXT2COPE data to determine relationships between cognitive variables (healthy lifestyle beliefs and perceived difficulty in leading a healthy lifestyle) and healthy lifestyle behaviors (Militello et al., 2016).

Results of TEXT2COPE reinforce findings that knowledge alone is not enough to change behavior, and that targeting beliefs is a key strategy for behavior change interventions. As parents gained confidence in their ability to engage in healthy choices for their families grew, their response rate to the static SMS lessened, and those who had less confidence continued to rely on SMS support (Militello et al., 2016). These data suggest that parents with lower self-efficacy for healthy lifestyle choices rely on continued reinforcement for continued engagement, and that text messaging can provide that reinforcement. Continued research should look into the effects of CT and other behavioral theories on parents' ability to make healthy choices for their children, and ways to raise parental self-efficacy for healthy lifestyle choices. Specifically, more research should consider how the use of stand-alone text message interventions can be used as a tool to increase parental self-efficacy for healthy lifestyle choices for themselves and their families.

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Sharifi and colleagues (2013) conducted a qualitative study on exploring text message interventions for parents as a medium for encouraging behavior change among children. The study recruited parents of children aged 6-12 years who were overweight or obese (e.g., BMI in the 85th percentile or higher) to participate in focus groups and interviews. To be eligible, parents were required to speak English and have a cell phone with text messaging capabilities. Five discussion groups were held for 90-120 minutes, each with approximately 6 participants. Focus groups included 26 open-ended questions that addressed parents' perspectives on the use of text messaging to support them in helping their children adhere to evidence-based behavior goals. Goals included increasing PA, reducing sugary beverages, ensuring adequate sleep, and limiting screen time. Mock 3-week interventions were completed, with participants receiving either real text messages or handwritten messages. Seven parents volunteered to participate in follow up interviews to further discuss their thoughts on text messaging interventions. Data compiled from focus groups and interviews showed parent enthusiasm and acceptability for text messaging. Parent preferences and recommendations for text messaging interventions were summarized in the following six categories:

Content

Parents expressed a desire for specific, action-oriented advice, such as tips on healthy meals, local PA opportunities, and healthy snacks. They did not like texts with general health information. They enjoyed encouraging/motivational messages, as well as messages concerning areas where they need work. This finding is similar to findings by Poorman and colleagues (2015) showing that motivational messages that encourage positive behavior are better received than educational messages that inform about what is healthy or advised behavior. Parents

wanted messages to be sensitive and non-stigmatizing, to avoid body image issues. Some parents thought weekly themes for message topics would be helpful.

Frequency/Timing/Duration

Parent responses to frequency inquiries varied. Some parents thought one text daily would be appropriate, but the majority thought twice per week would suffice. Parents thought as long as the advice remained relevant and novel they would continue to read and engage with the texts, but they would enjoy the option to increase or decrease message frequency themselves. Voice of Authority – Parents noted that a text from a health care provider could work as a "voice of authority," and may help validate parent's efforts to encourage behavior change.

Tailoring/Customization

There was a preference for relevant, tailored messages that took into account the child's age, gender, goals, knowledge, health conditions and neighborhood. Using the child's name and their doctor's name were also mentioned.

Interactivity

Most parents mentioned preferring to have on demand "live" support, via text message or phone.

Multimodal *(previously referred to as SMS plus)*

Parents suggested including email, websites, mobile apps or other supplemental technology with the text messages to enhance interactivity and provide access to more information.

The mock intervention showed that personal, tailored and relevant text messages, that come from a voice of authority, were believed to be the most desirable by parents, and that 3 messages per week was a good amount. Further research should be conducted to confirm that

such messages are desired in an actual intervention, and are relevant across diverse communities. Limited studies have investigated parental influence over behavior change in their children as a response to receiving text messages, and to our knowledge, none have done so on an AI Reservation.

CONCLUSION

Childhood obesity is a multi-faceted problem that has proven easier to prevent than to treat. Prevention efforts should include parent participation and are best directed at children who are aged 3-5. In Montana, a mostly rural state with many medically underserved populations, including those living on the state's seven American Indian Reservations, creative childhood obesity prevention methods should be attempted. Text messaging is a cost effective communication tool that is easily expandable to rural communities. It is a feasible and acceptable intervention medium for sending and receiving messages related to diet and exercise (Shaw & Bosworth, 2012).

Texting interventions that promote ongoing healthy household routines could fill a gap in obesity research. The Let's Go! 5-2-1-0 framework highlights the importance of building on existing community partnerships to ensure successful and sustained community based prevention interventions (Rogers et al., 2013). The Let's Go! 5-2-1-0 framework could be easily adapted into a texting intervention. There is a strong rationale for testing interventions that include text messaging for parents of young children on the topic of overweight/obesity prevention methods, especially in medically underserved rural areas and AI Reservations where there are high rates of childhood obesity.

Chapter Three: Methodology

Study Design

The SMS Parent Action iNtervention (SPAN) was a 5-week, quasi-experimental one-group, pre- to post- test pilot study. Text messaging (SMS) was used as a tool to provide information on child nutrition, physical activity, sleep and screen time behaviors to parents and caregivers with at least one child age 3 to 5 years old living in the household. Study feasibility was determined by collecting and analyzing recruitment and retention rates, receipt and response to text messages, participant satisfaction with message content, timing, frequency, and duration of text messages, and participant input on the intervention. The study also assessed the effect of text messages on parents' ability to influence health behaviors in their child, and whether or not parents changed their opinions about what constituted healthy behaviors as a result of receiving text messages. Specifically, these child behaviors were 1) getting at least 10 hours of sleep most days of the week, 2) eating at least five servings of fruits and vegetables each day of the week, 3) spending two or fewer hours watching television or doing recreational screen activities (such as video games) each day, 4) getting at least one hour of moderate physical activity each day, and 5) avoiding all sugary beverages, including fruit juices.

SPAN was conducted as part of an ongoing, grant funded partnership between researchers from a University and professionals from a tribal college and a tribal health department on an AI Reservation. The aim of the grant/partnership is to increase the capacity of academic and community researchers to identify and implement culturally appropriate intervention strategies for preventing childhood obesity on the Reservation. The partnership has a Community Advisory Board (CAB) that consists of teachers, principals, medical professionals, parents, tribal council representatives, community members, tribal health and tribal college staff,

city-county health department administrators, a church leader and government representatives. The CAB members provided input during many stages of the text-messaging pilot study, including the overall study design, recruitment strategies, and reviewing dissemination of findings materials which included this manuscript.

Recruitment

To begin recruitment, the lead investigator (JM) attended a local Head Start staff meeting on the Reservation to describe the study and ask for recruitment advice. The Head Start director suggested recruiting participants from parent meetings at Head Start centers (n=10) on the Reservation. Of the 10 Head Start centers, 3 were selected to recruit participants to the study. These locations were chosen because they were convenient for the project investigators to attend and had meetings scheduled that fit into the pilot study timeframe. At least one project staff attended one parent meeting at each Head Start center (n=3 parent meetings) between November and December 2016. During the meetings the project staff person described the study, informed participants there would be a $50 incentive, and answered parent questions. On average, these meetings lasted 20 minutes. Parents were then invited to fill out a screener to determine their eligibility for participating in the pilot study. Eligibility criteria were: (i) Parents or primary caregivers who make most of the decisions about physical activity (PA) and nutrition in the household, (ii) have at least one child aged 3-5 years who lives in the household during the week (e.g., primary parent/household) (iii) live on or near the Reservation, and (iv) own or have daily access to a cell phone with a plan that includes unlimited texting. If a parent met the eligibility requirements, he or she completed informed consent and were then asked to complete a pre-test survey.

In addition to directly recruiting parents to the study from Head Start centers, flyers describing the study and contact information were displayed and handed out at a local pediatrician's office, a local tribal college, and at all Head Start centers on the Reservation. Participants were also recruited by word of mouth (e.g., people who were enrolled in the study told people they knew who had children in the age range about the study). Parents who learned about the study from a flyer would call a project staff person to find out more information about the study. These phone calls took between 5 and 10 minutes. If the parent wanted to participate in the study, the staff person would then meet with the parent in person to fill out eligibility screener, informed consent and pre-test survey. These in-person meetings took approximately 15 minutes. Before the baseline measures began, the parent perception survey was piloted with 10 parents of young children and Head Start staff on the Reservation. Those piloting the survey provided information about clarity and relevance of the questions, and some questions were revised accordingly. The Institutional Review Board at the Reservations' tribal college monitored and approved the study.

Pilot study questionnaires and measurements

After a parent provided consent, he or she completed baseline measures. To evaluate likely effectiveness, pre- and posttest measures were administered before the 5-week intervention began (pre-test/baseline) and at the end of the 5-week intervention (posttest). These measures included self-report surveys with 10 questions on parents' desires for his or her child's behavior (psychosocial outcomes) and 10 questions on actual child behaviors (behavioral health outcomes) that were related to risk of obesity.

The majority of survey questions (16/20) were adapted from the 2013 Maine Integrated Youth Health Survey (MIYHS), a survey for parents of kindergarten children or third graders,

with modules for older students (Maine Department of Education & Maine Department of Health and Human Services, 2014). The survey covers a broad array of health topics (unintentional injury, substance abuse, sexual behavior, suicide/ depression). For the pilot study, we adapted and used questions on physical activity and nutrition as they were relevant to our five desired health behaviors. Additional questions (n=4) on sleep habits were written by project staff with guidance from and approval by our two healthcare provider partners (a pediatrician and a dietitian).

During the baseline measures, participants also completed a seven item demographic questionnaire reporting age, sex, gender, ethnicity, education and annual income levels. Participants also provided information about preferred times to receive text messages. Participants received a $50 cash incentive to participate in the study.

SPAN Intervention

SPAN participants were sent 3 text messages each week for five consecutive weeks between January and March 2017. Text messages were sent using Mosio, an online platform for text message automation that tracks whether participants received messages, responded to messages, and what their responses were. Messages were sent on a fixed frequency (three per week), but the timing of messages (which days and what time of day) was determined by participants. Messages were tailored specifically for participants with age and gender appropriate content, and by using the names of parents and their children in the messages. Messages were targeted to parents of young children living in a rural area on or near an AI Reservation. Each week's messages were approved by and appeared to be sent from a "voice of authority," who was a local pediatrician or a tribal health dietitian.

Each week, the text messages were about a different topic derived from work done by the national, "Let's Go! 5-2-1-0" campaign (Rogers et al., 2013). Let's Go! 5-2-1-0 is a multi-setting community-based approach to improve healthy eating and physical activity behaviors that are related to risk of overweight and obesity (Rogers et al., 2013). The mnemonic, 5-2-1-0, represents four recommendations for healthy living. Each day, children should eat at least five servings of fruits and vegetables, spend two or fewer hours watching television or doing recreational screen activities (such as video games), strive for at least one hour of moderate physical activity, and avoid all sugary beverages, including fruit juices (zero sugary drinks) (Rogers et al, 2013; Vinci, , 2016). Based on feedback from our Community Advisory Board members, information about sleep habits were added. Of the three weekly text messages participants received, the first described the weekly topic. Details on the five topics (Remembered as "10-5-2-1-0"), and the first text messages sent each week can be found in Table 1.

Table 1: Weekly Topics and Introductory Texts		
Week	**Topic (Mnemonic)**	**First Text Message Sent**
1	*Children should receive ten hours of sleep each night (10).*	Hi, I'm Dr. [local pediatrician's name]. I'm texting about sleep this week! Young children like [child's name] do best when they get 10+ hours of sleep each night.
2	*Children should eat at least five servings of fruits and vegetables daily (5).*	Hi, this is [dietician's name] Strive to feed [child's name] at least 5 servings of fruits & vegetables each day.
3	*Children should spend two or fewer hours watching television or doing recreational screen activities (such as video games) each day (2).*	Hi, it's Dr. [local pediatrician's name] again! The CDC recommends limited screen time for kids under 5 – no more than an hour/day of TV, cell phones, computers or video games. *
4	*Children should strive for at least one hour of moderate physical activity daily (1).*	Young kids need physical activity – try for at least an hour each day! Active play helps [child's name] develop strong muscles and good coordination skills. Running, kicking balls, and dancing all burn off extra energy – Dr. [local pediatrician's name]

| 5 | *Children should avoid all sugary beverages, including fruit juices (0).* | Hi, It's [dietician's name]. As a dietitian in the diabetes field, I know how unhealthy sugary drinks are for young children. It's best for kids not to drink sugary drinks – this includes soda, juice, and sports drinks. |

* This recommendation has been recently revised to 1 hour or less for children 5 years old and under, so we changed the text message accordingly.

The second weekly text message was a bi-directional (e.g., two-way communication) message. Participants were asked to respond to a question, then immediately received an automated feedback response based on their answer to the question. For example, the question about sleep associated with that topic (Week 1) was, "How many hours did [child's name] sleep on average the past few nights?" Participants then responded with how much sleep their child had the previous nights. Then participant's received a text message response praising participants whose children were meeting or exceeding the recommendations or a text message response offering encouragement and suggestions for parents whose children were below the national recommendations for sleep (Figure 1) The text messaging platform also allowed project staff to respond to additional participant questions or comments about the weekly topic.

Figure 1. Example of a SPAN Automatic Response Survey Question

Survey Question	Participant Answer	Automatic Response

How many hours did [child's name] sleep on average the past few nights? Please text back a number for your response. Thanks!

10+ → "Great job! Congratulate [child's name] for being on target with sleeping!"

8-9 → "[Child's name] is close to meeting the recommendation. Work together to think of small steps to help you reach the goal."

7 or less → "Keep working with [child's name] to think of small steps to allow for more sleep each night."

The third weekly text included links to outside sources such as websites and videos about the weekly topic. For example, the third text from week one read, "Wondering WHY sleep is so important? Here's a great website with games and info that you and [child's name] can visit together! http://sleepforkids.org/." Each participant received $50 cash upon completion of the study.

Data Analysis

To assess intervention feasibility, data was collected on recruitment and enrollment processes, how many participants received and responded to messages, text message clarity, frequency, duration, timing, and content value and participant input on the intervention. Data from all participants were included in the analysis regardless of level of participation in the intervention, although data was omitted from one participant who did not complete the pre-test survey. Demographic information, responses to weekly text message questions, and post-test questions on feasibility were included from all participants.

We described participant characteristics using mean and standard deviations. *To address feasibility*, we calculated recruitment and retention rates, as well as participant receipt and response to text messages, reported as percentages; we also report participant's perceptions of text message clarity, frequency, duration, timing, and content value as percentages, and number of text messages sent and received. Participants also provided written responses to questions on clarity, frequency, duration, timing, and content value.

To analyze *behavioral health and psychosocial outcome variables* (pre and post-test survey questions), we coded each question with a numerical value between 1 and 7, with 1 representing the least healthy outcome and 7 representing the most healthy outcome. We then

calculated a mean score of participant responses for each question and analyzed these data for

changes from pre- to posttest, by subtracting the pre-test value from the post-test value. A

positive change (increase from pre- to posttest) means healthy outcomes increased, while a

negative change (decrease from pre- to posttest) means outcomes became less healthy.

We calculated the mean total score of all questions to come up with the mean composite score

for the pre and posttest surveys. We then used a two-tailed paired samples t-test to detect

changes in mean scores from baseline (pretest) and end-of-treatment (posttest, 5 weeks after

baseline) in overall parent perception of healthy child behaviors and actual child behavior

outcome variables. These analyses were performed in SPSS 23 (SPSS Inc., Chicago, IL).

Statistical significance was set at the 0.05 alpha level.

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Chapter Four: Manuscript

SMS Parent Action iNtervention (SPAN): A pilot study to assess the feasibility of using text messaging to promote child health on an American Indian Reservation

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Abstract

 Purpose: Childhood obesity and its associated health risks are widely recognized as a major public health crisis in the United States (Johnson & Johnson, 2014; Proctor, 2008; Rogers et al, 2013; Vinci et al, 2016) and worldwide (Elías-Boneta, Toro, Garcia, Torres, & Palacios, 2015). Among children in low-income families, American Indian/Alaska Native (AIAN) children have the highest prevalence of obesity (21.1%) compared to other racial/ethnic groups (14.74% overall) (Pan et al, 2015). Parents play an important role in introducing healthy foods and

encouraging physical activity in young children (Birch & Ventura, 2009; Lindsay et al., 2006; Natale et al., 2014). Text messaging is an attractive means of communication because it is portable, cost-effective, accessible, and able to reach across demographic spheres to serve underserved and rural populations (Terry, 2008), and populations with poor health (Fjeldsoe, Marshall, & Miller, 2009). The primary purpose of this pilot study was to assess the feasibility of the SMS (Short Messaging System or text messaging) Parent Action iNtervention (SPAN) obesity prevention intervention for rural white and AI children.

Methods: This 5-week quasi-experimental pre- to posttest pilot study took place on a rural, American Indian (AI) reservation. Participants were parents whose children were 3 to 5 years old. During the intervention, participants received 3 text messages on a particular topic each week. Topics included childhood nutrition, physical activity and sleep requirements, and recommendations for limiting screen time and sugary beverage consumption. The main study measures were descriptions of study feasibility (recruitment and retention rates, receipt and response to text messages, satisfaction with message content, timing, frequency, and duration). We also collected information on pre- to posttest changes in participant knowledge/desires for their children related to healthy behaviors and parent-reported child behaviors.

Results: Over 8 weeks, 24 parents of young children expressed interest in participating in the study; following screening, 71% (17/24) met eligibility criteria and were consented to the study. At the end of the 5-week intervention, 100% (17/17) completed the texting intervention and final assessments. All intervention texts (n=289) sent to participants were successfully delivered. Of the 85 survey question texts that requested a response, 95% (81/85) were responded to with any answer, while 91% (78/85) were responded to by answering the survey question. All participants (17/17) reported they found the texts easy to understand and they liked the timing - what time of day they received the messages. Ninety-four percent (16/17) of participants reported enjoying the frequency (3 per week) with which they received messages, and participants either reported 5 weeks was a good amount of time or too short. At the end of the 5-week intervention, improvements were observed in some of the child behaviors.

Conclusion: Findings suggest it is feasible to deliver a text messaging-based childhood obesity prevention intervention to parents living on a rural, AI reservation. Text messages were well received by parents of young children and texting parents may influence child behavior. Our study targets gaps in the literature and helps guide future research using text messaging to promote child health and prevent obesity.

Background

Childhood obesity and its associated health risks are widely recognized as a major public health crisis in the United States (Johnson & Johnson, 2015; Proctor, 2008; Rogers et al, 2013; Vinci et al, 2016) and worldwide (Elías-Boneta, Toro, Garcia, Torres, & Palacios, 2015). In

Montana, 9.4% of adolescents are obese and 11.3% of 2 to 4 year olds whose parents participate

in the WIC program are obese (CDC, 2015)**.** Children living in rural areas have increased odds of

becoming obese, compared with those living in urban areas (Johnson & Johnson, 2015). More

than half (53%) of Montana's residents live in rural or frontier areas (Montana Department of

Public Health and Human Services, 2013). Among children in low-income families, American

Indian/Alaska Native (AIAN) children have the highest prevalence of obesity (21.1%) compared

to other racial/ethnic groups (14.74% overall) (Pan et al, 2015). Most of Montana's counties

experience a lack of essential services such as health care, and are designated as medically

underserved (Montana Department of Public Health and Human Services, 2013), suggesting a

need for innovative ways to provide health services. Text messaging, also referred to as short

message service (SMS) messaging, is an increasingly popular form of communication around the

world (Duggan & Rainie, 2012). Text messages are applicable to promoting healthy behaviors to

underserved populations (Poorman et al., 2015), but, to our knowledge, no research has been

done to determine if text messaging to prevent childhood obesity is feasible on an American

Indian Reservation in a rural setting.

  A few obesity prevention interventions that teach healthy habits at home during early

childhood and preschool years have been shown to be effective at reducing BMI for

overweight/obese children, or maintaining a healthy BMI and increasing fruit and vegetable

consumption (Castro, Samuels & Harman, 2013; Wofford, 2008). However, most studies focus

on treatment interventions in older children who are already overweight or obese, often in a

school setting (Cornish, Askelson, & Golembiewski, 2016; Yon & Johnson, 2014). This suggests

more studies should be conducted assessing home-based obesity prevention strategies that

incorporate parents and caregivers (PAC) as agents of behavior change for reducing risk of

obesity in their children (Faith et al., 2012; Militello et al., 2016). Behavior change strategies such as specifying target behaviors, self-monitoring, and goal setting are all useful tools for PACs who play a significant role in preventing overweight/obesity in their children (Faith et al., 2012).

Some studies have determined the feasibility of sending text-based messages to improve health in adolescents and adults. These studies show text messaging is feasible to implement (Iribarren et al., 2013; Richmond et al., 2015), is acceptable (Hingle, Nichter, Medeiros, & Grace, 2013; Shaw and Bosworth, 2012) is applicable as an intervention tool for adolescents and parents (Pattishall, Ellen a& Spector, 2013, and for addressing a number of health issues, including behavior change (Buhi et al., 2013; Price et al., 2015), smoking cessation (Boschert, 2014; Free et al., 2013; Müssener et al., 2016; Spohr et al., 2015), adherence to medication, (DeKoekkoek et al., 2015; Iribarren et al., 2013) and overweight/obesity (de Niet et al., 2012; Shaw & Bosworth, 2012; Silva et al., 2015). While these studies show that text messaging can be an effective tool for communicating health messages directly to adults or adolescents, few studies exist in the literature that use text-messaging to engage parents to promote behaviors that reduce risk of obesity in their child(ren).

While text messaging studies have focused on improving various health outcomes have produced positive results, Lim et al., point out "the impact of important variables on the success of a project; including the timing, frequency, duration, tailoring, and interactivity of text messaging has not been fully explored" (2014). Text messaging feasibility is defined as "the ability to transmit data via SMS to participants, the receipt of information by participants and the ability to communicate back to the researchers" (Shaw & Bosworth, 2012). Text messaging feasibility studies must include information about these variables, in addition to participant

engagement and retention (Fjeldsoe, Marshall & Miller, 2009). Determining the feasibility of text messaging is necessary because novel ways of delivering preventative health behavior messages to healthy individuals are sought after by health professionals and others (Fjeldsoe et al., 2009).

For the purpose of determining parent desires for the previously described feasibility variables (e.g., timing, frequency, duration, tailoring, interactivity) and text message content, Sharifi and colleagues conducted a qualitative study on text message interventions as a medium for encouraging behavior change among children (2013). The study recruited parents of children aged 6-12 years who were overweight or obese (e.g., BMI in the 85th percentile or higher) to participate in focus groups and interviews. Focus groups included 26 open-ended questions that explored parents' perspectives on the use of text messaging to support them in helping their children adhere to evidence-based behavior goals (e.g., increasing PA, reducing sugary beverages, ensuring adequate sleep, and limiting screen time). Following the focus groups, seven parents volunteered to participate in a mock texting intervention, where they received 3 weekly messages for 3 weeks. Participants were interviewed after the 3-week intervention on the same open-ended questions on the use of text messaging. Results showed that parents desired personal, tailored and relevant text messages that come from a voice of authority (Sharifi et al., 2013). Participants expected to enjoy encouraging/motivational messages, as well as messages about areas where they need work. Some parents thought weekly themes for message topics would be helpful. Some of these findings concur with a study by Poorman and colleagues (2015) who found that motivational messages encouraging positive behavior were better received by parents than educational messages informing about what is a healthy or advised behavior.

Collectively, the studies described above show AI and rural children are at a higher risk of developing overweight/obese, obesity prevention interventions that encourage parents to teach healthy habits at home during early childhood and preschool years are highly effective, and text messaging can be used to convey health messages. However, to our knowledge, there are no text messaging studies in the literature for parents of young children living on or near a rural, AI Reservation, where barriers may exist to receive and respond to text messages about preventing childhood obesity. These barriers could include inconsistent cell phone or text message usage, parents of young children not having access to regular health care workers who can provide information, and parents feeling resistance to receiving and/or responding to messages. Thus, the primary purpose of this pilot study was to establish the feasibility of an obesity prevention texting intervention for parents of young children living on or near an AI Reservation in a rural setting.

Methods

Study Design

The SMS Parent Action iNtervention (SPAN) was a 5-week, quasi-experimental one-group, pre- to post- test pilot study. Text messaging (SMS) was used as a tool to provide information on child nutrition, physical activity, sleep and screen time behaviors to parents and caregivers with at least one child age 3 to 5 years old living in the household. Study feasibility was determined by collecting and analyzing recruitment and retention rates, receipt and response to text messages, participant satisfaction with message content, timing, frequency, and duration of text messages, and participant input on the intervention. The study also assessed the effect of text messages on parents' ability to influence health behaviors in their child, and whether or not parents changed their opinions about what constituted healthy behaviors as a result of receiving

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text messages. Specifically, these child behaviors were 1) getting at least 10 hours of sleep most days of the week, 2) eating at least five servings of fruits and vegetables each day of the week, 3) spending two or fewer hours watching television or doing recreational screen activities (such as video games) each day, 4) getting at least one hour of moderate physical activity each day, and 5) avoiding all sugary beverages, including fruit juices.

SPAN was conducted as part of an ongoing, grant funded partnership between researchers from a University and professionals from a tribal college and a tribal health department. The aim of the grant/partnership is to increase the capacity of academic and community researchers to identify and implement culturally appropriate community intervention strategies for preventing childhood obesity on the Reservation. The partnership has a Community Advisory Board (CAB) that consists of teachers, principals, medical professionals, parents, tribal council representatives, community members, tribal health and tribal college staff, city-county health department administrators, a church leader and government representatives. The CAB members provided input during many stages of the text-messaging pilot study, including the overall study design, recruitment strategies, and reviewing dissemination of findings materials which included this manuscript.

Recruitment

To begin recruitment, the lead investigator (JM) attended a local Head Start staff meeting on the Reservation to describe the study and ask for recruitment advice. The Head Start director suggested recruiting participants from parent meetings at Head Start centers (n=10) on the Reservation. Of the 10 Head Start centers, 3 were selected to recruit participants to the study. These locations were chosen because they were convenient for the project investigators to attend and had meetings scheduled that fit into the pilot study timeframe. At least one project staff

attended one parent meeting at each Head Start center (n=3 parent meetings) between November and December 2016. During the meetings the project staff person described the study, informed participants there would be a $50 incentive, and answered parent questions. On average, these meetings lasted 20 minutes. Parents were then invited to fill out a screener to determine their eligibility for participating in the pilot study. Eligibility criteria were: (i) Parents or primary caregivers who make most of the decisions about physical activity (PA) and nutrition in the household, (ii) have at least one child aged 3-5 years who lives in the household during the week (e.g., primary parent/household) (iii) live on or near the Reservation, and (iv) own or have daily access to a cell phone with a plan that includes unlimited texting. If a parent met the eligibility requirements, he or she completed informed consent and were then asked to complete a pre-test survey.

In addition to directly recruiting parents (e.g., proactive recruitment) to the study from Head Start centers, we indirectly recruited parents (e.g., reactive recruitment) to the study by displaying and handing out flyers describing the study and contact information, and by word of mouth. Flyers were displayed and handed out at a local pediatrician's office, a local tribal college, and at all Head Start centers on the Reservation, and people who were enrolled in the study told people they knew who had children in the age range about the study. Parents who learned about the study from a flyer or friend would call a project staff person to find out more information about the study. These phone calls took between 5 and 10 minutes. If the parent wanted to participate in the study, the staff person would then meet with the parent in person to fill out eligibility screener, informed consent and pre-test survey. These in-person meetings took approximately 15 minutes. Before the baseline measures began, the parent perception survey was piloted with 10 parents of young children and Head Start staff on the Reservation. Those piloting

the survey provided information about clarity and relevance of the questions, and some questions were revised accordingly. The Institutional Review Board at the local tribal college on the Reservation approved and monitored the study.

Pilot study questionnaires and measurements

After a parent provided consent, he or she completed baseline measures. To evaluate likely effectiveness, pre- and posttest measures were administered before the 5-week intervention began (pre-test/baseline) and at the end of the 5-week intervention (posttest). These measures included self-report surveys with 10 questions on parents' desires for his or her child's behavior (psychosocial outcomes) and 10 questions on actual child behaviors (behavioral health outcomes) that were related to risk of obesity.

The majority of survey questions (16/20) were adapted from the 2013 Maine Integrated Youth Health Survey (MIYHS), a survey for parents of kindergarten children or third graders, with modules for older students (Maine Department of Education & Maine Department of Health and Human Services, 2014). The survey covers a broad array of health topics (unintentional injury, substance abuse, sexual behavior, suicide/ depression). For the pilot study, we adapted and used questions on physical activity and nutrition as they were relevant to our five desired health behaviors. Additional questions (n=4) on sleep habits were written by project staff with guidance from and approval by our two healthcare provider partners (a pediatrician and a dietitian).

During the baseline measures, participants also completed a seven item demographic questionnaire reporting age, sex, gender, ethnicity, education and annual income levels. Participants also provided information about preferred times to receive text messages. Participants received a $50 cash incentive to participate in the study.

SPAN Intervention

SPAN participants were sent 3 text messages each week for five consecutive weeks between January and March 2017. Text messages were sent using Mosio, an online platform for text message automation that tracks whether participants received messages, responded to messages, and what their responses were. Messages were sent on a fixed frequency (three per week), but the timing of messages (which days and what time of day) was determined by participants. Messages were tailored specifically for participants with age and gender appropriate content, and by using the names of parents and their children in the messages. Messages were targeted to parents of young children living in a rural area on or near an AI reservation. Each week's messages were approved by and appeared to be sent from a **"**voice of authority," who was a local pediatrician or a tribal health dietitian.

Each week, the text messages were about a different topic derived from work done by the national, "Let's Go! 5-2-1-0" campaign (Rogers et al., 2013). Let's Go! 5-2-1-0 is a multi-setting community-based approach to improve healthy eating and physical activity behaviors that are related to risk of overweight and obesity (Rogers et al., 2013). The mnemonic, 5-2-1-0, represents four recommendations for healthy living. Each day, children should eat at least five servings of fruits and vegetables, spend two or fewer hours watching television or doing recreational screen activities (such as video games), strive for at least one hour of moderate physical activity, and avoid all sugary beverages, including fruit juices (zero sugary drinks) (Rogers et al., 2013; Vinci et al., 2016). Based on feedback from our Community Advisory Board members, information about sleep habits were added. Of the three weekly text messages participants received, the first described the weekly topic. Details on the five topics

(Remembered as "10-5-2-1-0"), and the first text messages sent each week can be found in table

1.

Table 1: Weekly Topics and Introductory Texts		
Week	**Topic (Mnemonic)**	**First Text Message Sent**
1	*Children should receive <u>ten</u> hours of sleep each night (10).*	Hi, I'm Dr. [local pediatrician's name]. I'm texting about sleep this week! Young children like [child's name] do best when they get 10+ hours of sleep each night.
2	*Children should eat at least <u>five</u> servings of fruits and vegetables daily (5).*	Hi, this is [dietician's name] Strive to feed [child's name] at least 5 servings of fruits & vegetables each day.
3	*Children should spend <u>two</u> or fewer hours watching television or doing recreational screen activities (such as video games) each day (2).*	Hi, it's Dr. [local pediatrician's name] again! The CDC recommends limited screen time for kids under 5 – no more than an hour/day of TV, cell phones, computers or video games. *
4	*Children should strive for at least <u>one</u> hour of moderate physical activity daily (1).*	Young kids need physical activity – try for at least an hour each day! Active play helps [child's name] develop strong muscles and good coordination skills. Running, kicking balls, and dancing all burn off extra energy – Dr. [local pediatrician's name]
5	*Children should avoid all sugary beverages, including fruit juices (0).*	Hi, It's [dietician's name]. As a dietitian in the diabetes field, I know how unhealthy sugary drinks are for young children. It's best for kids not to drink sugary drinks – this includes soda, juice, and sports drinks.

* This recommendation has been recently revised to 1 hour or less for children 5 years old and under, so we changed the text message accordingly.

The second weekly text message was a bi-directional (e.g., two-way communication) message. Participants were asked to respond to a question, then immediately received an automated feedback response based on their answer to the question. For example, the question about sleep associated with that topic (Week 1) was, "How many hours did [child's name] sleep on average the past few nights?" Participants then responded with how much sleep their child had the previous nights. Then participant's received a text message response praising participants whose children were meeting or exceeding the recommendations or a text message response

offering encouragement and suggestions for parents whose children were below the national

recommendations for sleep (Figure 1). The text messaging platform also allowed project staff to

respond to additional participant questions or comments about the weekly topic.

Figure 1. Example of a SPAN Automatic Response Survey Question

Survey Question	Participant Answer	Automatic Response
How many hours did [child's name] sleep on average the past few nights? Please text back a number for your response. Thanks!	10+	"Great job! Congratulate [child's name] for being on target with sleeping!"
	8-9	"[Child's name] is close to meeting the recommendation. Work together to think of small steps to help you reach the goal."
	7 or less	"Keep working with [child's name] to think of small steps to allow for more sleep each night."

The third weekly text included links to outside sources such as websites and videos about

the weekly topic. For example, the third text from week one read, "Wondering WHY sleep is so

important? Here's a great website with games and info that you and [child's name] can visit

together! http://sleepforkids.org/."

Data Analysis

To assess intervention feasibility, data was collected on recruitment and enrollment

processes, how many participants received and responded to messages, text message clarity,

frequency, duration, timing, and content value and participant input on the intervention.

Data from all participants were included in the analysis regardless of level of

participation in the intervention, although data was omitted from one participant who did not

complete the pre-test survey. Demographic information, responses to weekly text message questions, and post-test questions on feasibility were included from all participants.

We described participant characteristics using mean and standard deviations. *To address feasibility*, we calculated recruitment and retention rates, as well as participant receipt and response to text messages, reported as percentages; we also report participant's perceptions of text message clarity, frequency, duration, timing, and content value as percentages, and number of text messages sent and received. Participants also provided written responses to questions on clarity, frequency, duration, timing, and content value.

To analyze *behavioral health and psychosocial outcome variables* (pre and post-test survey questions), we coded each question with a numerical value between 1 and 7, with 1 representing the least healthy outcome and 7 representing the most healthy outcome. We then calculated a mean score of participant responses for each question and analyzed these data for changes from pre- to posttest, by subtracting the pre-test value from the post-test value. A positive change (increase from pre- to posttest) means healthy outcomes increased, while a negative change (decrease from pre- to posttest) means outcomes became less healthy.

We calculated the mean total score of all questions to come up with the mean composite score for the pre and posttest surveys. We then used a two-tailed paired samples t-test to detect changes in mean scores from baseline (pretest) and end-of-treatment (posttest, 5 weeks after baseline) in overall parent perception of healthy child behaviors and actual child behavior outcome variables. These analyses were performed in SPSS 23 (SPSS Inc., Chicago, IL). Statistical significance was set at the 0.05 alpha level.

Results

Recruitment

At three parent meetings, 13 families were told about the study. One parent/caregiver each from seven of the families enrolled in the study. No parent/caregivers from the remaining families enrolled because they didn't meet eligibility criteria, either because they didn't know how to text message or have text messaging capabilities (n=1), or didn't have children in the right age range (n=5). All eligible participants (n=7) recruited through proactive recruitment methods were enrolled in the study.

Approximately 50 flyers were distributed to Head Start locations and one physician's office, to be handed out to interested parents. Ten additional participants were recruited either by receiving a flyer or hearing about the study through word of mouth. In total, the researchers received calls from 13 people, but were only able to meet with 10 people, due to scheduling issues and not hearing back from potential participants.

18 participants met eligibility following screening by a trained research staff. Of these, one participant was not enrolled because the informed consent form was not returned and 3 attempts to reach the parent to sign another form before the intervention began were unsuccessful; 17 participants provided consent, completed all baseline measures, and began the 5-week texting intervention. The mean age of parent participants was 34.1 years ($SD = 6.9$ years); nearly half (47.1%) of the participants identified their race as Native American/Alaska Native; 58.8% lived in households with annual incomes > $30,000; 70.6% were college graduates with an Associate's Degree or higher (Table 2).

Table 2. Baseline Characteristics of SPAN study participants (n = 17)			
Participant Characteristics (parents)	Statistic	Participant Characteristics (parents)	Statistic
Age (years), M (SD)	34.1 (6.9)	**Gender (n, %)**	
Race/Ethnicity* (n, %)		Female	15 (88.2)
White	11 (64.7)	Male	2 (11.8)
Native American/ Alaska Native	8 (47.1)	**Yearly Family Income (n, %)**	
Native Hawaiian/ Pacific Islander	1 (5.9)	$10,000 to $20,000	3 (17.6)
Hispanic or Latino (n, %)		$20,000 to $30,000	4 (23.5)
Yes	1(5.9)	$30,000 to $40,000	3 (17.6)
No	16 (94.1)	$40,000 to $50,000	2 (11.8)
Total Number of children in Household (n, %)		$50,000 and above	5 (29.4)
One	1 (5.9)	**Years of School Completed (n, %)**	
Two	8 (47.1)	High School Diploma/GED	1 (5.9)
Three	6 (35.3)	Some College or Associates Degree	7 (41.2)
Four	2 (11.8)	College Degree	7 (41.2)
		Graduate Degree	2 (11.8)

*Categories don't add up to 100 because participants could report more than one race.

Intervention Feasibility

The primary focus of the pilot study was to determine the feasibility of the childhood obesity prevention text messaging intervention. In addition to participant receipt and response to text messages, we collected and analyzed participant responses about text message content, frequency, timing, duration, and participant input on the intervention. These responses were determined by looking at responses to multiple choice questions and written responses to open-ended questions. These outcomes are described below.

c. **Participant receipt and response to text messages (Table 3)**

All intervention texts (n=289) sent to participants were successfully delivered. Of the 85 survey question texts that requested a response, 95% (81/85) were responded to with any answer, while 91% (78/85) were responded to by answering the survey question. None of the participants

opted-out of receiving messages throughout the 5-week intervention. Additionally, 41.2% (7/17)

of participants wrote unsolicited responses to the first or third weekly text.

Table 3. Participant receipt and response to text messages	
Feasibility factors	N (%)
Intervention Texts	
Texts sent	289
Texts received by participants	289 (100)
Survey Questions	
Total Sent	85
Total Responses Received	81 (95.3)
Appropriate responses*	78 (91.8)
Opt-out	
Participants who opted-out of receiving text messages	0 (0)

* responses that answered survey question

b. Text message content, frequency, timing and duration (Figure 2)

All participants (17/17) reported they found the texts easy to understand and they liked

the timing – what time of day they received the messages. Ninety-four percent (16/17) of

participants reported enjoying the frequency (3 per week) with which they received messages,

while the remaining reported wanting more frequent messages. When asked about the 5-week

duration of the intervention, 70.5% (12/17) of participants reported 5 weeks was a good amount

of time, while 41.6% (5/17) reported they would have liked the program to be longer.

Figure 2: Text Message Clarity, Timing, Frequency and Duration

WERE TEXTS EASY TO UNDERSTAND?
Yes: 17
No: 0

TIMING
I liked the timing: 17
I didn't like the timing: 0

FREQUENCY
Would have liked fewer: 0
Three was a good amount: 16
Woud have liked more: 1

DURATION
5 weeks was too long: 0
5 weeks was a good amount: 12
5 weeks wasn't enough: 5
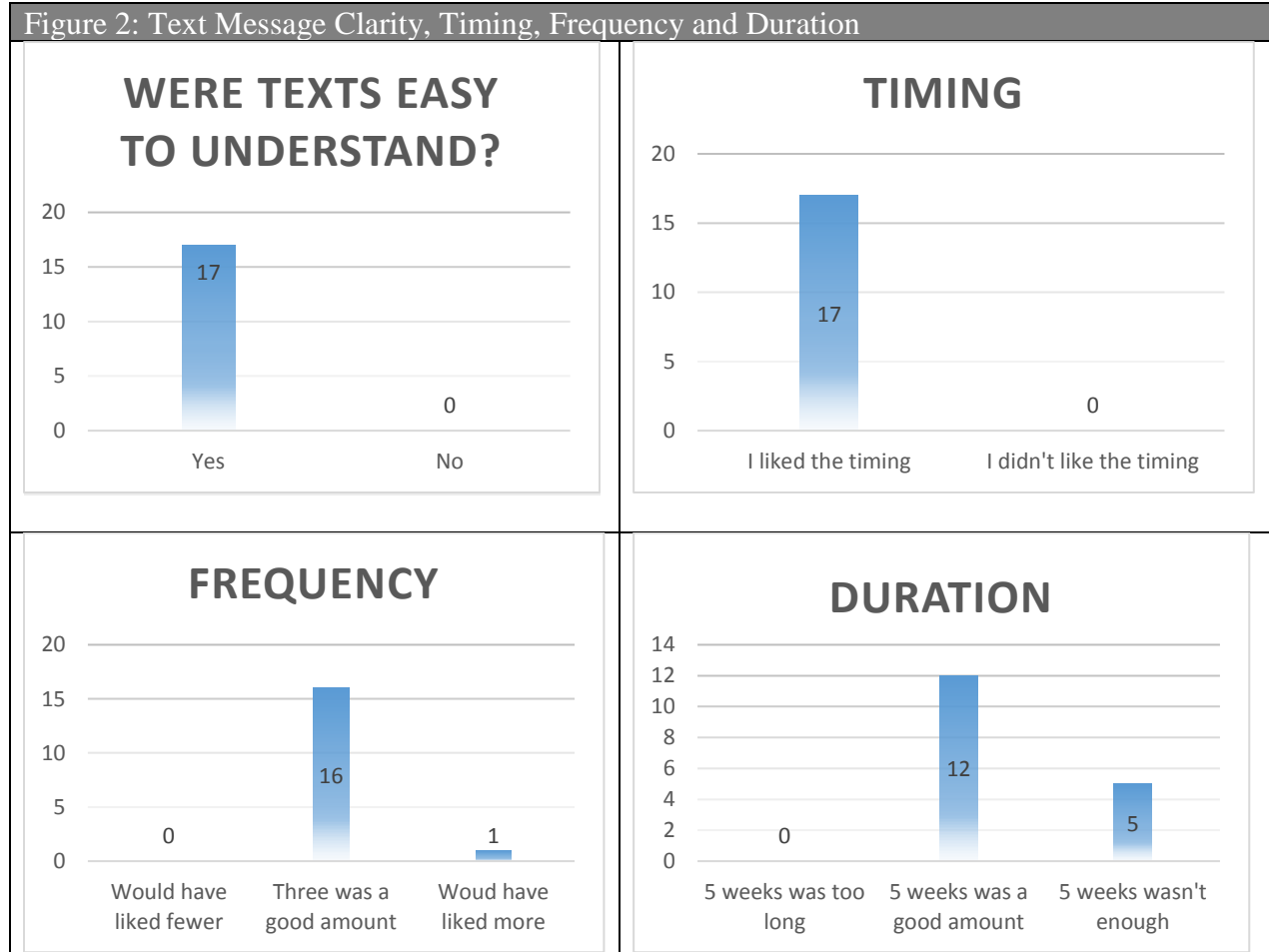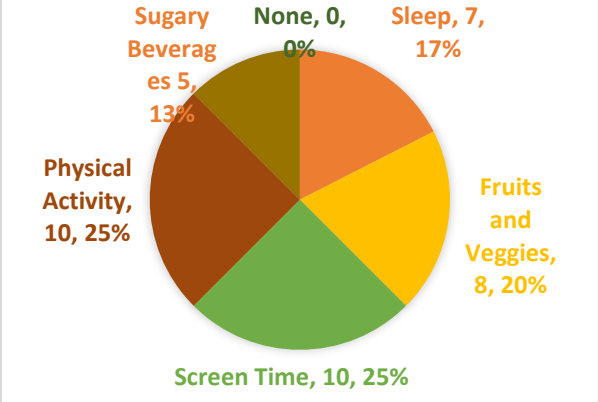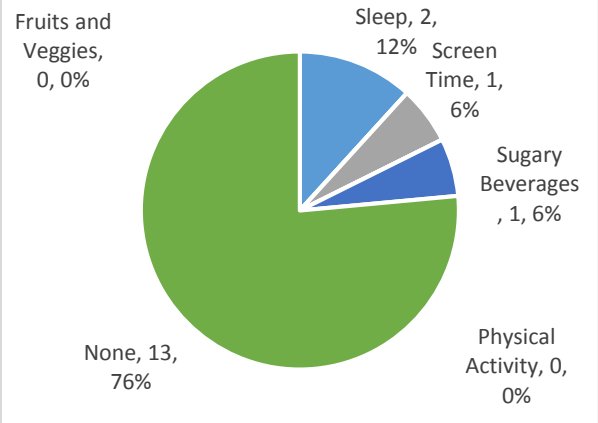
c. Post-test Survey Written Responses (Table 4)

When asked if the text messages were easy to understand, 83.3% (10/12) of participants who responded said the texts were clear, straightforward and/or to the point. Two participants (16.7%; 2/12) mentioned the use of links and websites to add additional information. Of 5 responses about the texting intervention duration, 3 people (60%) suggested the intervention last 10 weeks instead of 5, one person suggested "or more information such as: better eating, activities & such", and another participant wrote "good info". When asked which topics were most helpful, each of the 5 weekly topics was selected, but Screen Time and Physical Activity

were selected most often, with 10 votes each (participants could vote for more than one). None of the participants reported that they didn't find any of the weekly topics helpful. When asked which questions were least helpful, the majority of respondents (64.3%; 9/14 responses) thought that all the information was helpful, while 3 respondents (21.4%; 3/14) stated that they already knew some of the information provided. The remaining two responses included a realization, "But it made me realize how much I depend on other people/daycare & preschool to limit screen time and give fruits and veg, limit sugary beverages," and a suggestion, "Sleep is hard to change. Concrete ideas for change would be more helpful." When participants were asked for additional feedback about the texting intervention, 73.3% (11/15 responses) provided positive feedback. One participant stated "I thought it was a great way to be reminded about your child's healthy habits and care." The remaining four responses included suggestions for improvement, such as including more information in the first weekly text, and including a memo option for survey questions so participants can explain *why* they answered that way, and being more personable with automatic responses.

Table 4: Post-test Survey Written Responses		
Question	**Response trends**	**Sample Responses**
Overall, did you find the text messages were easy to understand?	58.8% (10/17) stated texts were clear, straightforward and/or to the point.	"They gave all of the information needed to answer the question and weren't lengthy." "They were straight forward, easy to follow." "They were to the point and easy to understand."
Which topics from the texts did you find to be most helpful? (Participants could choose more than one answer)	Sugary Beverages 5, 13%; None, 0, 0%; Sleep, 7, 17%; Physical Activity, 10, 25%; Fruits and Veggies, 8, 20%; Screen Time, 10, 25%	"I thought I was allowing the right amount but it was too much screen time." "My daughter already follows the necessary allowed times for each, so it's good to know I'm doing good with my choices." "These topics covered helped me gain a better understanding of what my child needs." "It was nice to be able to tell my 5-year-old why we don't have too much screen time."
Which topics did you find to be least helpful?	Fruits and Veggies, 0, 0%; Sleep, 2, 12%; Screen Time, 1, 6%; Sugary Beverages, 1, 6%; None, 13, 76%; Physical Activity, 0, 0%	"Each text was informational and helpful." "I loved them all." "But it made me realize how much I depend on other people/daycare & preschool to limit screen time and give fruits and veg, limit sugary beverages."
Is there anything else about the texting program you'd like to tell us?	68.7% (11/17) provided positive feedback.	"I thought it was a great way to be reminded about your child's healthy habits and care." "Overall, it was a good program to take part in. I learned important information in an easy way, without having to sit through a class or appointment of some sort."

Psychosocial Outcomes

In addition to addressing feasibility, this study looked at whether or not parents changed their views about what constituted healthy child behaviors as a result of receiving text messages. There was not a significant difference in the mean composite score for parent perceptions on healthy behaviors for their children on the post-test (M=58.9, SD=4.3) compared to the pre-test (M=57.4, SD=5.61); t (15)=1.45, p=0.17.

At posttest, most responses (n=7) to survey questions about parent knowledge and desires for their child regarding health behaviors showed higher mean scores (e.g. parental knowledge/desires for their child's behavior associated with obesity prevention improved), compared to pretest (Table 5). These included TV and screen time, fruit, vegetable and fruit juice consumption, number of days children got 60 minutes of physical activity, and sleep on school nights. However, some responses at posttest (n=3) went in the opposite direction of what was predicted for these variables (e.g., there was a decrease in parental knowledge/desires for a behavior lowering their child's risk of obesity). These data included sleep on weekends, desired daily minutes of physical activity, and number of times parents wanted their children to drink sugary beverages

Table 5: Participants' knowledge/desires for their children			
Question topic	**Pre-test response (m)**	**Post-test response (m)**	**Post minus Pre**
Hours of sleep on weekends	5.13	5	-0.13
Desired minutes of daily physical activity	6.75	6.63	-0.12
Times wanted soda or sugary beverage to be consumed	6.53	6.5	-0.03
Screen time on a school day	5.81	5.88	0.07
Hours of sleep on school nights	5.22	5.31	0.09
Times 100% fruit juice consumed	5.38	5.56	0.18
Vegetable consumption desired	5.5	5.75	0.25
Desired number of days physically active for 60 minutes	6.63	6.88	0.25
Hours of TV should be watched on a school day	5.12	5.59	0.47
Number of times parent would like child to eat fruit each week	5.31	5.84	0.53

m = mean question score

Behavioral Health Outcomes

This study also looked at parents' ability to influence health behaviors in their young child. There was a significant difference in the mean composite score for parent reported child behaviors on the post-test (M=51.2, SD=5.9) and the pre-test (M=54.2, SD=5.5); t(15)=-2.5, p=.025. At posttest, most responses (n=8) to survey questions about parent-reported child behaviors showed higher mean scores (e.g. child behavior associated with obesity prevention improved), compared to pretest (Table 6). Positive changes were seen in hours of sleep on weekends and school nights, number of times fruits and vegetables were consumed, hours of TV watched, number of days children were physically active, and number of minutes of PA per day, and number of fruit drinks consumed. Responses to two posttest questions showed lower mean scores than the pre-test (e.g., child behavior associated with obesity became less healthy). These included hours of screen time on school days and times sugary beverages were consumed.

Table 6: Parent-reported child behaviors			
Question topic	**Pre-test response (m)**	**Post-test response (m)**	**Post minus pre**
Hours of sleep on school nights	4.69	5.06	+0.37
Hours of sleep on weekend nights	4.31	4.81	+0.50
Times fruit was eaten	5.06	5.31	+0.25
Number of vegetables consumed	4.63	4.69	+0.06
Hours of TV watched on a school day	4.44	4.9	+0.46
Minutes of daily physical activity	6	6.5	+0.50
Number of days physically active for 60 minutes	5.41	5.94	+0.53
Times 100% fruit juice was consumed	5.07	5.63	+0.56
Times soda or other sugary beverage was consumed	6.44	6.19	-0.25
Hours of screen time on school day	5.63	5.56	-0.07

m = mean question score

Discussion

Feasibility

The findings of this study indicate a high feasibility of implementing a text messaging-based childhood obesity prevention intervention for parents of young children living on or near a rural, American Indian Reservation. We were able to recruit participants to the study, despite difficulties with meeting and collecting pre- and post-test measures across a large rural Reservation in winter weather conditions. However, the recruitment and enrollment phase did take longer than expected (e.g., 8 weeks versus 4 weeks) and we had fewer participants (n=17) than the 32 participants we had originally anticipated. A possible solution to decreasing barriers for recruiting and enrolling participants is using text messages instead of in-person enrollment (Lim et al., 2014). Using this method requires an "opt-in" approach, where participants initiate their enrollment by sending a text message, then answering questions and completing all enrollment measures via text. Our study was "opt-out," meaning parents enrolled in person and received messages until they chose to stop or the intervention ended. While using text messaging

to recruit and enroll participants may be easier for researchers, it is difficult to validate

participant characteristics, such as age and gender, and engagement and participation rates may

be lower if people find it to be less personal (Lim et al., 2014). Further research should be

conducted to determine the most effective and efficient way to recruit participants for text

message interventions.

Many people on the AI Reservation used "no-contract" phone carriers and many changed

their phone numbers frequently. We were unsure if texting would be successful for this reason,

along with information from a local child program director that parents in the area are sometimes

difficult to get in contact with (child program director, personal communication, October 31,

2016). However, we were able to send text messages and parents were able to receive them, and

they responded at a higher rate than expected (91%). In addition to the requested responses to

survey questions, seven participants also responded to the first and third weekly text at least one

time. One participant responded nine times to texts other than survey questions. While we found

no correlation between frequency of texting and changes between pre to post-test, this response

frequency contributes to our findings of high feasibility of text messaging. Like our study, a

mobile health SMS feasibility study done by Ammerman and Weiss (2015) demonstrated that

the majority of participants engaged in two-way communication via text message. Interventions

that allow for two-way messaging have previously been shown to be more successful than those

where participants can't reply (Poorman et al., 2015). Especially considering the amount of

unsolicited responses (41% of participants) our study shows that even in a rural area, participants

can participate in two-way communication.

To our knowledge, previous studies have not examined using the Let's Go! 5-2-1-0

framework as content for text messages. Our study results show using this framework is an

effective way to deploy simple messages about healthy choices across multiple community settings. The simple messages translate well to text message format which only allows 160 characters per message, and despite their brevity, participants found the messages to be clear and easy to understand. This mirrors previous findings that text messages, while short, can sufficiently impart useful health information (Ammerman & Weiss, 2015).

Our study was modeled closely to the mock texting study done by Sharifi and colleagues in 2013, since it was one of few studies on using texts as an obesity prevention tool for parents, but had not been tested in an actual intervention. Sharifi et al. found that parents expressed a desire for specific, action-oriented advice, such as tips on healthy meals, local PA opportunities, and healthy snacks (2013). Our study showed similar results; participants enjoyed clear advice on specific health topics, as evidenced by their reporting that all health topics were helpful, and participant comments such as the following: "I feel my son needs to eat more vegetables and the fruit and veg[etable] information helped."

In the study by Sharifi and colleagues, parents suggested including email, websites, mobile apps or other supplemental technology with the text messages to enhance interactivity and provide access to more information (2013), a practice called *SMS Plus* (Spohr et al., 2015*)*. Our study also supports the use of SMS Plus interventions, as participants mentioned they liked the additional resources offered in the third, weekly text message. However, the use of SMS plus interventions has had mixed results. A meta-analysis found that SMS plus interventions were not significantly better than text only interventions (Spohr et al., 2015), mirroring results found by Head and colleagues (2013). Further research should be done to determine if SMS Plus is a useful component of text messaging interventions.

Previous research has questioned the appropriate number of weekly text messages to send to study participants. Sharifi et al., (2103), found some parents thought one text daily would be appropriate, but the majority thought twice per week would suffice. Parents thought as long as the advice remained relevant and novel they would continue to read and engage with the texts, but they would enjoy the option to increase or decrease message frequency themselves (Sharifi et al., 2013). Similarly, in a 2013 meta-analysis, Head and colleagues found the most successful texting interventions were those that allow participants to personalize when and how often they receive messages and those whose message frequency decreases over the course over the study (Head et al., 2013). Varied message timing and content also contributes to increased engagement and fewer ignored messages (Poorman et al., 2015). Although our study remained static with 3 weekly messages at the same time each week, and didn't provide the option to decrease message frequency, participants were asked to choose when they received the messages. All participants reported either enjoying the frequency or wanting more frequent messages. Perhaps because our intervention was only 5 weeks long it didn't lose its novelty so participants remained engaged. Future research should continue to examine engagement rates over a longer period of time in relation to message frequency.

Participants are more likely to engage with texts when they feel the messages are meant for them specifically and use appropriate names and pronouns. Previous research has shown a preference for (Head et al., 2013; Sharifi et al., 2013), and higher efficacy of (Fjeldsoe et al., 2009; Head et al., 2013) tailored text messages for health behavior change; these findings concur with ours.

Psychosocial Changes

The majority of survey responses on participant knowledge and desires for their children showed change in a positive direction in terms of preventing childhood obesity, indicating parents may have learned about healthy child behaviors as a result of the texting intervention. However, it is not clear whether increased parental knowledge led to changes in child behaviors related to risk of obesity. Other studies have looked at whether or not parental knowledge, beliefs and self-efficacy have a positive influence on their child. The TEXT2COPE pilot study was conducted with 15 parents of overweight/ obese children to determine the feasibility, acceptability and preliminary effects of a seven-week cognitive behavioral therapy (CBT) based skill building program that used a combination of in-clinic visits, homework and text messages as triggers to motivate, remind, and facilitate behavior (Militello, 2014). Skills included knowledge on nutrition and physical activity, problem solving, goal setting, effective communication, positive self-talk, and positive thinking. Results of TEXT2COPE show that knowledge alone is not enough to change behavior, and that targeting beliefs is a key strategy for behavior change interventions (Militello, 2014). Our study showed a stronger change in parent-reported child behaviors than in parent perceptions/beliefs about what comprises healthy behaviors. Although we didn't investigate the relationship between these factors, our research may present an opposing finding to those of Militello in that child behaviors, albiet parent reported, seemed to improve without a large change in parent beliefs. Further research could determine whether parents must change beliefs in order to influence healthy childhood behaviors. Militello and colleagues used text messaging as triggers while our study looked at the use of text messaging as a stand-alone intervention. Future research should continue to examine the use of stand-alone text message interventions as a tool to increase parental self-efficacy for healthy lifestyle choices for themselves and their families.

Research by Nsiah-Kumi and colleagues (2009) examined the relationship between PAC perception of health risks for overweight children and PAC self-efficacy for influencing dietary and PA behaviors in their children, especially considering any family history of diabetes or cardiovascular disease. They found that parents of pre-school age children had higher rates of self-efficacy for influencing diet and behavior than those with older children, and suggested clinicians and pediatricians highlight the importance of doing so to parents with young children (Nsiah-Kumi et al., 2009). Noting the modest positive shift in PAC knowledge and desires for their children and the corresponding positive shift in child behaviors seen in our study, along with findings of Nsiah-Kumi et al., (2009) future research should continue to explore whether prevention efforts using text messages aimed at parents of pre-school children have a larger impact than treatment interventions for parents of older children.

Research by Ricci and colleagues (2012) conducted with a rural Montana AI Reservation community looked at correlations between parent physical activity, dietary behaviors and support for their children's (ages 10-14) nutrition and physical activity behaviors, and the BMI of their child (2012) to assess the roles of parents in supporting their child's behaviors associated with obesity. This observation study found significant positive associations between parent support and youth BMI percentile for both physical activity and nutrition. Findings suggest a need for future research to determine what variables (parental, societal and/or community) influence children to engage in PA and healthy eating habits, and the age at which the variables would have the strongest impact on healthy behaviors (Ricci et al., 2012). Our study used an intervention to show that parent actions (receiving and responding to text messages) can influence healthy childhood behaviors (including PA and healthy eating) for those living on an AI Reservation, confirming observations by Ricci and colleagues. Our study also suggests that

parents of young children (3-5 years old) who live on an AI Reservation may be ideal candidates for childhood obesity prevention efforts.

Behavioral Health Changes

Our study observed a significant change in child behaviors related to risk of obesity, as reported by parents, between the beginning and end of the intervention, which was surprising for such a short intervention. The largest change occurred in hours of television children reportedly watched each day.

Other studies have found high feasibility of text messaging to support behavior change, (Iribarren et al., 2013; Lim, Wright & Hellard, 2014; Pattishall et al., 2013; Price et al., 2015; Shapiro et al., 2008; Shaw & Bosworth, 2012), but few studies involved texting parents to change child behavior, and even fewer did so using text messaging as a stand-alone intervention. Militello et al. conducted an in-person intervention to prevent childhood obesity by working with parents of young children that was supported by text messaging. Their study reported a significant increase in self-reported healthy lifestyle behavior choices from pre- to post-test (Militello et al., 2016), as did ours, although ours did so without the use of in-person intervention. Future studies should use a study design that includes a rigorous sample size and control group to determine if childhood obesity related behavior changes were a result of parents receiving text messages, and conduct a series of post-test follow up measures to determine if the text-messaging intervention can maintain these behavior changes for a long period of time.

Strengths

A major strength of this study was its strong community involvement throughout various stages (planning, recruiting and collecting outcome data), including input received from the CAB. The initial idea to do a texting intervention was suggested by the Head Start director, an

AI member of the CAB. Although we were working on an AI Reservation with unknown levels of cell phone use we found texting was a highly feasible form of communication.

Limitations

This study had several limitations. The timing of this study may have contributed to difficulties with recruitment. Due to our limited time frame, we recruited parents in November and December. These months are busy times for families, and winter travel conditions most likely limited the number of parents who attended Head Start parent meetings. Ideally we would have recruited at the beginning of the school year when parents were attending orientation or at the doctor's office for their children's annual physical examinations.

By recruiting only participants who have cell phones with texting capabilities, some of the population was excluded from the study and thus, results may not be generalizable to the wider population. The study's primary aim was to assess the feasibility of implementing the text-messaging childhood obesity prevention intervention in rural, AI communities and thus, a formal sample size calculation was not conducted. The literature suggests that conducting sample size calculations for feasibility and pilot studies may not be appropriate (Bilingham, Whitehead & Julious, 2013). However, future studies should include a larger sample size and explore longer program duration – up to 10 weeks, to rigorously evaluate the efficacy of text messaging on an AI Reservation. In addition, our study was only conducted on one AI Reservation in Montana with three federally-recognized tribes, and thus, may not be generalizable for the 326 AI Reservations in the U.S. with more than 550 federally-recognized tribes.

While pre- and post-test surveys were piloted with local parents and professionals, text message content was only reviewed by the local pediatrician and dietician who served as "voices

of authority." Future research should pilot the text message content with the target population before beginning the intervention to ensure clarity and satisfaction.

Our study combined many different texting variables, including message targeting, tailoring, a "voice of authority," two-way communication, and a fixed duration. It also provided a $50 incentive to participants. Without further research it is difficult to isolate how any one of these factors contributed to the high feasibility of text messaging intervention. Continued research could include a component analysis to determine the influence individual variables have on participants.

Although our study showed positive changes in both PAC knowledge and beliefs about what constitutes healthy childhood behavior and parent-reported child behaviors, due to the pre- to posttest study design with no comparison group, we can't conclude that any changes were a result of our intervention. Considering the short duration of the program (5 weeks), and our use of self-reporting, parents may have remembered pre-test measures and reported healthier behaviors than actually occurred. Future research could track child PA and sleep with electronic devices, or ask for daily reports on diet as a more rigorous way to determine changes in child health behaviors. In addition, future studies could calculate the relationship between parent knowledge/beliefs about healthy childhood behaviors and actual changes in child behaviors to determine any correlation.

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Appendix

Participant Screener

SMS Parent Action iNtervention (SPAN) Study Eligibilty Screener

   1 In your family, which parent/guardian makes most of the day to day decisions about food and physical activity for the children?

Parent/guardian name: _____Phone number: _____

   1 Parent/guardian questions:

     Do you own or have regular access to a cell phone? Yes ☐ No ☐

     Does your phone have unlimited texting? Yes ☐ No ☐

     Do you live on or near the [name of the Reservation]? Yes ☐ No ☐

   1 Please list your children aged 3-5 years-old who attend Early Childhood Services Head Start. Head start location:

	Child's Name	Age	Gender
1			
2			
3			

4. If your family is selected for the study, do you agree to:

- Receive and read three text messages each week for five weeks? Yes ☐ No ☐
- Respond to one text message each week for five weeks? Yes ☐ No ☐
- Fill out two written surveys? Yes ☐ No ☐

SPAN Pre-test Survey

SMS Parent Action iNtervention (SPAN) Pre-Test Survey

Parent/Guardian Questionnaire
The purpose of this survey is to learn about you and your child's current health behaviors. Please fill it out to the best as best as you can. Please answer as many questions as you can. Research staff will keep confidential research related records and information from this survey. If the results of this study are shared, information that may identify you will not be used.
Part I - Demographic Information (about you, the parent)

1. Age (years) _____   2. ☐Female   ☐Male   ☐Other

3A. Please indicate your ethnic category:
1☐ Hispanic or Latino   2☐ Not Hispanic or Latino

3B. Please indicate your racial category:
1☐ Native American or Alaska Native   2☐ Native Hawaiian/other Pacific Islander
3☐ White   4☐ Black or African American
5☐ Asian

4. Years of school completed:
1☐ Less than high school   4☐ Associate's degree
2☐ High school diploma/GED   5☐ College degree
3☐ Some college   6☐ Graduate degree

5. Yearly family income (check the box next to the range that best applies):
1☐ $ 00.00 - $10,000   5☐ $40,000 - $50,000
2☐ $10,000 - $20,000   6☐ $50,000 – above
3☐ $20,000 - $30,000   7☐ Don't know family income
4☐ $30,000 - $40,000

6a. Total number of children in your household age 3 – 5 years old: _____
(If more than one, please only complete the survey for_____)

6b. Total number of children in your household (all ages):_____

7. When is the best time for you to receive texts each day? Please write at least three specific times below. If you don't want any texts on a certain day, please leave blank.

	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
For Example	*12 -1pm*	*7-8 pm*		*12-1 pm*	*8-10am*		

What is the cell phone number you'd like us to text? _____

Part II – The following questions ask about **your child's behaviors**. Some questions ask <u>what your child currently does</u>, and others ask what <u>you would like them to do</u>. Please answer by checking the best answer:

1) In the past 7 days, how many times <u>did</u> your child **eat fruit**? (Not including fruit juice).

☐ 0 times in the past 7 days   ☐ 2 times per day
☐ 1-3 times in the past 7 days   ☐ 3 times per day
☐ 4-6 times in the past 7 days   ☐ 4 or more times per da
☐ 1 time per day

2) How many times <u>would you like</u> your child to **eat fruit** each week? (Not including1 fruit juice).

☐ Never   ☐ 2 times per day
☐ 1-3 times per week   ☐ 3 times per day
☐ 4-6 times per week   ☐ 4 or more times per day
☐ 1 time per day

3) On an average day, how many minutes <u>is</u> your child **physically active**? (Add up all the time your child did any physical activity that increased his or her heart rate and made your child breathe hard some of the time – such as playing soccer, running around, jumping on a trampoline, riding a bike, walking, etc.)

☐ Less than 5 minutes per day   ☐ 30 - 40 minutes per day
☐ 5 -10 minutes per day   ☐ 40 - 50 minutes per day
☐ 10 – 20 minutes per day   ☐ More than 50 minutes per day
☐ 20 – 30 minutes per day

4) On an average day, how many minutes <u>do you want</u> your child to be **physically active**? (Include any physical activity that would increase his or her heart rate and make your child breathe hard some of the time – such as playing soccer, running around, jumping on a trampoline, riding a bike, walking, etc.)

☐ Less than 5 minutes per day   ☐ 30 - 40 minutes per day
☐ 5 -10 minutes per day   ☐ 40 - 50 minutes per day
☐ 10 – 20 minutes per day   ☐ More than 50 minutes per day
☐ 20 – 30 minutes per day

5) During the past 7 days, how many times <u>did</u> your child drink 100% fruit juices such as orange juice, apple juice, or grape juice? (Do not count punch, Kool-Aid, sports drinks, or other fruit-flavored drinks.)

☐ My child didn't drink 100% fruit juice in the past 7 days
☐ 1-3 times in the past 7 days
☐ 4-6 times in the past 7 days

☐ 1 time per day
☐ 2 times per day
☐ 3 times per day
☐ 4 or more times per day

6) How many times <u>would you like</u> your child to drink 100% fruit juices such as orange juice, apple juice, or grape juice? (Do not count punch, Kool-Aid, sports drinks, or other fruit-flavored drinks.)

☐ Never
☐ 1-3 times each week
☐ 4-6 times each week
☐ 1 time per day

☐ 2 times per day
☐ 3 times per day
☐ 4 or more times per day

7) On an average **school day**, how many hours <u>does</u> your child **watch TV**?

☐ My child does not watch TV on an average school day
☐ Less than 1 hour per day
☐ 1 hour per day

☐ 2 hours per day
☐ 3 hours per day
☐ 4 hours per day
☐ 5 or more hours per day

8) On an average **school day**, how many hours <u>should</u> your child **watch TV**?

☐ My child shouldn't watch any TV on an average school day
☐ Less than 1 hour per day
☐ 1 hour per day

☐ 2 hours per day
☐ 3 hours per day
☐ 4 hours per day
☐ 5 or more hours per day

9) In the past 7 days, how many times <u>did</u> your child **eat vegetables** such as carrots, corn, squash, celery, green salad, or green beans? (Do not include French fries or other fried veggies).

☐ 0 times in the past 7 days
☐ 1-3 times in the past 7 days
☐ 4-6 times in the past 7 days
☐ 1 time per day

☐ 2 times per day
☐ 3 times per day
☐ 4 or more times per day

10) How much <u>would you like</u> your child to **eat vegetables** such as carrots, corn, squash, celery, green salad, or green beans? (Do not include French fries or other fried veggies).

☐ Never   ☐ 2 times per day
☐ 1-3 times per week   ☐ 3 times per day
☐ 4-6 times per week   ☐ 4 or more times per day
☐ 1 time per day

11) In the past 7 days, how many times <u>did</u> your child drink a can, bottle, or glass of soda, sports drink, energy drink, or other **sugar sweetened beverage** such as Gatorade, Red Bull, lemonade, sweetened tea or coffee drink, flavored milk, Snapple or Sunny Delight? (Do not count diet soda, other diet drinks or 100% fruit juice.)

☐ 0 times in the past 7 days   ☐ 2 times per day
☐ 1-3 times in the past 7 days   ☐ 3 times per day
☐ 4-6 times in the past 7 days   ☐ 4 or more times per day
☐ 1 time per day

12) How many times <u>would you like</u> your child to drink a can, bottle, or glass of soda, sports drink, energy drink, or other **sugar sweetened beverage** such as Gatorade, Red Bull, lemonade, sweetened tea or coffee drink, flavored milk, Snapple or Sunny Delight? (Do not count diet soda, other diet drinks or 100% fruit juice.)

☐ Never   ☐ 2 times per day
☐ 1-3 times per week   ☐ 3 times per day
☐ 4-6 times per week   ☐ 4 or more times per day
☐ 1 time per day

13) On an average **school day**, how many hours <u>does</u> your child play video or computer games, or use a computer for something other than school work? (Also called "**Screen Time**" - count time spent on things such as X Box, PlayStation, an iPod, an iPad or other tablet, a smart phone, YouTube, Facebook or other social networking tools, and the internet.)

☐ My child never has "screen time"   ☐ 3 hours per day
☐ Less than 1 hour per day   ☐ 4 hours per day
☐ 1 hour per day   ☐ 5 or more hours per day
☐ 2 hours per day

14) On an average **school day**, how many hours <u>should</u> your child play video or computer games, or use a computer for something other than school work? (Also called "**Screen Time**" - count time spent on things such as X Box, PlayStation, an iPod, an iPad or other tablet, a smart phone, YouTube, Facebook or other social networking tools, and the internet.)

☐ My child should never have "screen time"
☐ Less than 1 hour per day
☐ 1 hour per day

☐ 2 hours per day
☐ 3 hours per day
☐ 4 hours per day
☐ 5 or more hours per day

15) On an average **school night**, how many hours of **sleep** <u>does</u> your child get?

☐ 12 or more hours of sleep
☐ 11 hours of sleep
☐ 10 hours of sleep
☐ 9 hours of sleep

☐ 8 hours of sleep
☐ 7 hours of sleep
☐ 6 or fewer hours of sleep

16) On an average **school night**, how many hours of **sleep** <u>would you like</u> your child to get?

☐ 12 or more hours of sleep
☐ 11 hours of sleep
☐ 10 hours of sleep
☐ 9 hours of sleep

☐ 8 hours of sleep
☐ 7 hours of sleep
☐ 6 or fewer hours of sleep

17) On an average **weekend night**, how many hours of **sleep** <u>does</u> your child get?

☐ 12 or more hours of sleep
☐ 11 hours of sleep
☐ 10 hours of sleep
☐ 9 hours of sleep

☐ 8 hours of sleep
☐ 7 hours of sleep
☐ 6 or fewer hours of sleep

18) On an average **weekend night**, how many hours of **sleep** <u>should</u> your child get?

☐ 12 or more hours of sleep
☐ 11 hours of sleep
☐ 10 hours of sleep
☐ 9 hours of sleep

☐ 8 hours of sleep
☐ 7 hours of sleep
☐ 6 or fewer hours of sleep

19) During the past 7 days, on how many days <u>was</u> your child **physically active** for at least 60 minutes per day? (Add up all of the time your child did any physical activity that increased his or her heart rate and made your child breathe hard some of the time.)

☐ 0 days   ☐ 4 days
☐ 1 day   ☐ 5 days
☐ 2 days   ☐ 6 days
☐ 3 days   ☐ 7 days

20) How many days <u>would you like</u> your child to be **physically active** for at least 60 minutes per day? (Include did any physical activity that would increase his or her heart rate and make your child breathe hard some of the time.)

☐ 0 days   ☐ 4 days
☐ 1 day   ☐ 5 days
☐ 2 days   ☐ 6 days
☐ 3 days   ☐ 7 days

Appendix Three: SPAN Post-test Survey

SMS Parent Action iNtervention (SPAN) Post-Test Survey
Parent/Guardian Questionnaire
The purpose of this survey is to learn about you and your child's current health behaviors. Please fill it out to the best as best as you can. Please answer as many questions as you can. Research staff will keep confidential research related records and information from this survey. If the results of this study are shared, information that may identify you will not be used.

Part I - Please answer the following questions about **the text messages you received** by checking the best answer and writing responses:

Overall, did you find the text messages were easy to understand?

☐ Yes   ☐ No

Please describe why or why not.

_____

_____

How did you feel about the **frequency** of the text messages? (i.e. 3 each week)

☐ I would have liked fewer text messages each week (3 was too many).
How many texts per week would you like? _____

☐ Three per week was a good amount.

☐ I would have liked more text messages each week (3 was not enough).
How many texts per week would you like? _____

How did you feel about the **duration** of the text messages? (i.e. for 5 weeks)

☐ I would have liked a shorter time frame (5 weeks was too long to get text messages).
How many weeks would you like? _____

☐ Five weeks was a good amount.

☐ I would have liked more weeks of text messages.
How many weeks would you like to receive messages? _____

Participant ID_____

How did you feel about the **timing** of the text messages? (what time of day they were sent)

☐ I didn't like the timing of when the text messages arrived.
What time(s) didn't you like getting texts? _____

Why?_____

What time(s) would you prefer?_____

☐ I liked when the text messages arrived.

Which of the following topics from the texts did you find to be **most helpful**? (you can choose more than one)

☐ Sleep   ☐ Screen Time   ☐ Sugary Beverages
☐Fruits & Vegetables   ☐ Physical Activity   ☐ None

Please describe why.

_____

_____

1. Which of the following topics from the texts did you find to be **the least helpful**? (you can choose more than one)

   ☐ Sleep   ☐ Screen Time   ☐ Sugary Beverages
   ☐ Fruit and Vegetable   ☐ Physical Activity   ☐ None

Please describe why.

_____

_____

2. Is there anything else about the texting program that you'd like to tell us?

_____

_____

Part II – The following questions ask about **your child's behaviors**. Some questions ask <u>what your child currently does</u>, and others ask what <u>you would like them to do</u>. Please answer by checking the best answer:

1. In the past 7 days, how many times <u>did</u> your child **eat fruit**? (Not including fruit juice).

    ☐ 0 times in the past 7 days   ☐ 2 times per day
    ☐ 1-3 times in the past 7 days   ☐ 3 times per day
    ☐ 4-6 times in the past 7 days   ☐ 4 or more times per day
    ☐ 1 time per day

2. How many times <u>would you like</u> your child to **eat fruit** each week? (Not including fruit juice).

    ☐ Never   ☐ 2 times per day
    ☐ 1-3 times per week   ☐ 3 times per day
    ☐ 4-6 times per week   ☐ 4 or more times per day
    ☐ 1 time per day

3. On an average day, how many minutes <u>is</u> your child **physically active**? (Add up all the time your child did any physical activity that increased his or her heart rate and made your child breathe hard some of the time – such as playing soccer, running around, jumping on a trampoline, riding a bike, walking, etc.)

    ☐ Less than 5 minutes per day   ☐ 30 - 40 minutes per day
    ☐ 5 -10 minutes per day   ☐ 40 - 50 minutes per day
    ☐ 10 – 20 minutes per day   ☐ More than 50 minutes per day
    ☐ 20 – 30 minutes per day

4. On an average day, how many minutes <u>do you want</u> your child to be **physically active**? (Include any physical activity that would increase his or her heart rate and make your child breathe hard some of the time – such as playing soccer, running around, jumping on a trampoline, riding a bike, walking, etc.)

    ☐ Less than 5 minutes per day   ☐ 30 - 40 minutes per day
    ☐ 5 -10 minutes per day   ☐ 40 - 50 minutes per day
    ☐ 10 – 20 minutes per day   ☐ More than 50 minutes per day
    ☐ 20 – 30 minutes per day

5. During the past 7 days, how many times <u>did</u> your child drink 100% fruit juices such as orange juice, apple juice, or grape juice? (Do not count punch, Kool-Aid, sports drinks, or other fruit-flavored drinks.)

☐ My child didn't drink 100% fruit juice in the past 7 days
☐ 1-3 times in the past 7 days
☐ 4-6 times in the past 7 days

☐ 1 time per day
☐ 2 times per day
☐ 3 times per day
☐ 4 or more times per day

6. How many times <u>would you like</u> your child to drink 100% fruit juices such as orange juice, apple juice, or grape juice? (Do not count punch, Kool-Aid, sports drinks, or other fruit-flavored drinks.)

☐ Never
☐ 1-3 times each week
☐ 4-6 times each week
☐ 1 time per day

☐ 2 times per day
☐ 3 times per day
☐ 4 or more times per day

7. On an average **school day**, how many hours <u>does</u> your child **watch TV**?

☐ My child does not watch TV on an average school day
☐ Less than 1 hour per day
☐ 1 hour per day

☐ 2 hours per day
☐ 3 hours per day
☐ 4 hours per day
☐ 5 or more hours per day

8. On an average **school day**, how many hours <u>should</u> your child **watch TV**?

☐ My child shouldn't watch any TV on an average school day
☐ Less than 1 hour per day
☐ 1 hour per day

☐ 2 hours per day
☐ 3 hours per day
☐ 4 hours per day
☐ 5 or more hours per day

9. In the past 7 days, how many times <u>did</u> your child **eat vegetables** such as carrots, corn, squash, celery, green salad, or green beans? (Do not include French fries or other fried veggies).

☐ 0 times in the past 7 days
☐ 1-3 times in the past 7 days
☐ 4-6 times in the past 7 days
☐ 1 time per day

☐ 2 times per day
☐ 3 times per day
☐ 4 or more times per day

10. How much <u>would you like</u> your child to **eat vegetables** such as carrots, corn, squash, celery, green salad, or green beans? (Do not include French fries or other fried veggies).

    ☐ Never   ☐ 2 times per day
    ☐ 1-3 times per week   ☐ 3 times per day
    ☐ 4-6 times per week   ☐ 4 or more times per day
    ☐ 1 time per day

11. In the past 7 days, how many times <u>did</u> your child drink a can, bottle, or glass of soda, sports drink, energy drink, or other **sugar sweetened beverage** such as Gatorade, Red Bull, lemonade, sweetened tea or coffee drink, flavored milk, Snapple or Sunny Delight? (Do not count diet soda, other diet drinks or 100% fruit juice.)

    ☐ 0 times in the past 7 days   ☐ 2 times per day
    ☐ 1-3 times in the past 7 days   ☐ 3 times per day
    ☐ 4-6 times in the past 7 days   ☐ 4 or more times per day
    ☐ 1 time per day

12. How many times <u>would you like</u> your child to drink a can, bottle, or glass of soda, sports drink, energy drink, or other **sugar sweetened beverage** such as Gatorade, Red Bull, lemonade, sweetened tea or coffee drink, flavored milk, Snapple or Sunny Delight? (Do not count diet soda, other diet drinks or 100% fruit juice.)

    ☐ Never   ☐ 2 times per day
    ☐ 1-3 times per week   ☐ 3 times per day
    ☐ 4-6 times per week   ☐ 4 or more times per day
    ☐ 1 time per day

13. On an average **school day**, how many hours <u>does</u> your child play video or computer games, or use a computer for something other than school work? (Also called "**Screen Time**" - count time spent on things such as X Box, PlayStation, an iPod, an iPad or other tablet, a smart phone, YouTube, Facebook or other social networking tools, and the internet.)

    ☐ My child never has "screen time"   ☐ 3 hours per day
    ☐ Less than 1 hour per day   ☐ 4 hours per day
    ☐ 1 hour per day   ☐ 5 or more hours per da
    ☐ 2 hours per day

14. On an average **school day**, how many hours <u>should</u> your child play video or computer games, or use a computer for something other than school work? (Also called "**Screen Time**" - count time spent on things such as X Box, PlayStation, an iPod, an iPad or other tablet, a smart phone, YouTube, Facebook or other social networking tools, and the internet.)

☐ My child should never have "screen time"
☐ Less than 1 hour per day
☐ 1 hour per day

☐ 2 hours per day
☐ 3 hours per day
☐ 4 hours per day
☐ 5 or more hours per day

15. On an average **school night**, how many hours of **sleep** <u>does</u> your child get?

☐ 12 or more hours of sleep
☐ 11 hours of sleep
☐ 10 hours of sleep
☐ 9 hours of sleep

☐ 8 hours of sleep
☐ 7 hours of sleep
☐ 6 or fewer hours of sleep

16. On an average **school night**, how many hours of **sleep** <u>would you like</u> your child to get?

☐ 12 or more hours of sleep
☐ 11 hours of sleep
☐ 10 hours of sleep
☐ 9 hours of sleep

☐ 8 hours of sleep
☐ 7 hours of sleep
☐ 6 or fewer hours of sleep

17. On an average **weekend night**, how many hours of **sleep** <u>does</u> your child get?

☐ 12 or more hours of sleep
☐ 11 hours of sleep
☐ 10 hours of sleep
☐ 9 hours of sleep

☐ 8 hours of sleep
☐ 7 hours of sleep
☐ 6 or fewer hours of sleep

18. On an average **weekend night**, how many hours of **sleep** <u>should</u> your child get?

☐ 12 or more hours of sleep
☐ 11 hours of sleep
☐ 10 hours of sleep
☐ 9 hours of sleep

☐ 8 hours of sleep
☐ 7 hours of sleep
☐ 6 or fewer hours of sleep

19. During the past 7 days, on how many days <u>was</u> your child **physically active** for at least 60 minutes per day? (Add up all of the time your child did any physical activity that increased his or her heart rate and made your child breathe hard some of the time.)

    ☐ 0 days   ☐ 4 days
    ☐ 1 day   ☐ 5 days
    ☐ 2 days   ☐ 6 days
    ☐ 3 days   ☐ 7 days

20. How many days <u>would you like</u> your child to be **physically active** for at least 60 minutes per day? (Include did any physical activity that would increase his or her heart rate and make your child breathe hard some of the time.)

    ☐ 0 days   ☐ 4 days
    ☐ 1 day   ☐ 5 days
    ☐ 2 days   ☐ 6 days
    ☐ 3 days   ☐ 7 days