

DEVELOPMENT AND TESTING OF A TEXT MESSAGING EDUCATIONAL
INTERVENTION FOR PREGNANT ADOLESCENTS

A DISSERTATION
SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
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IN THE GRADUATE SCHOOL OF THE
TEXAS WOMAN'S UNIVERSITY

COLLEGE OF NURSING

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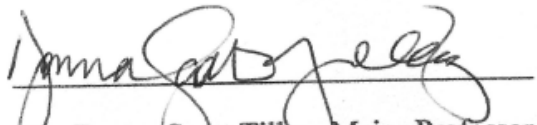
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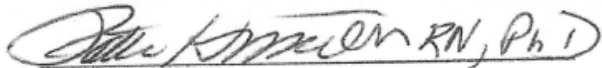
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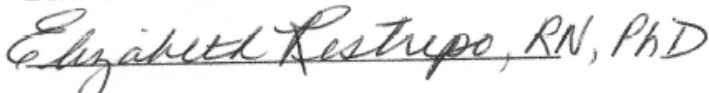
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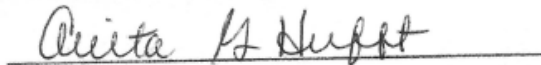
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DEDICATION

For my husband, Eric Martin,
and my sons and their families;
Clint, Ashley, Madeline & Emma,
and Zane & Emilie;
thank you for your never-ending
encouragement, patience, and love.

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ABSTRACT

RHONDA R. MARTIN

DEVELOPMENT AND TESTING OF A TEXT MESSAGING EDUCATIONAL INTERVENTION FOR PREGNANT ADOLESCENTS

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This study developed a literature based educational text messaging intervention, utilizing professional and adolescent subject matter experts (SMEs) to assess the content validity of the intervention, and pilot test the intervention for effect on pregnant adolescents' knowledge of nutrition and physical activity. Pregnant adolescents tend to utilize prenatal care inconsistently and have problems with weight gain during pregnancy (CDC, 2000; Harper, Chang, & Macones, 2011; Ludwig & Currie, 2010; Perron et al., 2010; Wilson, Damle, Huang, Landy, & Gomez-Lobo, 2012). Questions have arisen regarding whether pregnant women are receiving education needed to eat healthy and be active during pregnancy. Several studies identified that women know to eat healthy and exercise but not specifically what to eat, what kind of activity to perform, or where to get the information (Collins & Champion, 2014; Hearn, Miller, & Lester, 2014; Krans & Chang, 2012; Lucas, Charlton, & Yeatman, 2014; Reyes, Klotz, & Herring, 2013). It is unclear if adolescents have knowledge about nutrition and physical activity to keep gestational weight gain within recommended guidelines (Institute of Medicine, 2009; Lucas et al., 2014).

An educational text message intervention was developed by the investigator, based on professional experience, recommendations and guidelines of professional organizations, and support in the literature. Professional subject matter experts (SME's) evaluated the text message intervention for relevancy, sufficiency, and clarity. A consensus was reached by the SME's through the evaluation and rating of the intervention. The intervention was then evaluated for relevancy and clarity by pregnant adolescents SME's, in focus group settings. Focus group comments were analyzed using constant comparative method. After final review and approval by the professional SME's, a small pilot study was conducted. Pretest-posttest data was obtained from the pilot study and interpreted utilizing the ANOVA and Wilcoxon signed ranks test.

In conclusion, the professional and adolescent focus group SMEs indicated the text message tool had content validity through their rankings and agreement. The pilot study was small and finished without a definite conclusion, encouraging further study opportunities. An educational text message intervention is ready to be tested in a larger sample of pregnant adolescents.

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CHAPTER I

INTRODUCTION

According to the World Health Organization (WHO) approximately 17 million infants are born to adolescent mothers each year (2012). Infants born with low or high birth weight (under 2500 grams or over 4000 grams) are disproportionately born to mothers in their teenage years. Delivery of infants in these weight groups is associated with more complications and traumatic births. As part of the Millennium Development Goals (MDGs), the United Nations (2000) has initiated a global focus on improving maternal health care during pregnancy and the outcomes of pregnancy. Now, practitioners are attempting to address these goals in a variety of ways, including the use of technology.

Teenage or adolescent pregnancy is when a pregnancy occurs from 13-19 years of age (United Nations Children's Fund [UNICEF], 2008). Greater numbers of pregnancies occur in later adolescent years than in the earlier years (Centers for Disease Control and Prevention [CDC], 2000; Martin, Hamilton, Osterman, Curtin, & Mathews, 2013; World Health Organization [WHO], 2012). Each year there are approximately 305,388 births to adolescents in the United States (Markovitz, Cook, Flick, & Leet, 2005; Martin et al., 2013).

Pregnancy, a normal process, is a time of great change in the mother's body as the fetus is rapidly developing. The best outcomes are seen in pregnancies in which the

mother is at the optimal weight before becoming pregnant, has diseases such as diabetes mellitus in tight control, and gains weight within the recommended Institute of Medicine (IOM) guidelines. The IOM released revised recommendations for weight gain in pregnancy in 2009. These guidelines are based on pre-pregnant weight and a fixed range of weight gain divided into four categories: (a) underweight, (b) normal weight, (c) overweight, and (d) obese. Pregnant adolescents do not have separate weight gain guidelines, but are included in the general guidelines, according to their weight. According to several authors (Chung et al., 2013; Durie, Thornburg, & Glantz, 2011), gestational weight gain (GWG) less than recommended, resulted in low birth weight (LBW) infants (less than 2500 grams) in all groups except obese. Further, GWG in excess of the recommended rate resulted in high birth weight (HBW) infants (over 4000 grams) in all groups.

Low birth weight infants to adolescents have been observed for many years (Markovitz et al., 2005; Wilson, Damle, Huang, Landy, & Gomez-Lobo, 2012). In addition to preterm delivery, low birth weight among infants born to adolescents has been a major focus of the March of Dimes over the years. Currently, with the increased amount of obesity in the general population in both children and adults, there are increasing numbers of high birth weight infants born to adolescents (CDC – Birth Weight, 2013; Harper, Chang, & Macones, 2011; Ludwig & Currie, 2010).

An aspect important to healthy pregnancy is monitoring that should occur throughout the pregnancy. Prenatal monitoring is vital for assessment of mothers' weight

gain or loss, growth of the fetus, vital signs, and risk of complications (Gilbert, 2011). Guidelines for optimal prenatal care identify a range of 7-12 visits throughout pregnancy beginning by the 10th week of gestation unless the woman contacts the practitioner earlier (Akkerman et al., 2012; CDC, 2000). Adolescents typically initiate prenatal care later than adults (March of Dimes, 2011) or have no prenatal care (CDC, 2000). Late prenatal care is care which begins after the end of the first trimester or 12 weeks gestation (CDC, 2000). Starting prenatal care late reduces the total time available to monitor the health of the mother and the fetus. A missed appointment is a missed opportunity for assessment by a health care provider of the health of mother and fetus. The more appointments that are missed the greater the chance that complications, such as excess weight gain or loss, can occur without timely identification and therefore intervention (Debiec, Paul, Mitchell, & Hitti, 2010; Simpson & Creehan, 2014).

The increasing focus on improving perinatal outcomes has caused obstetric health care practitioners to seek new or additional methods to improve patient care. The use of technology has been increasing in all areas of health care for over 10 years, with rapid movement into the outpatient population. Mobile telephones, the fastest growing technology worldwide, are now utilized by health care consumers in their own health monitoring, maintenance and improvement (Cole-Lewis & Kershaw, 2010; Petrie, Perry, Broadbent, & Weinman, 2011). Smart telephones (calls and texting) have been used in prevention and management of various diseases (Cole-Lewis & Kershaw, 2010; Petrie et al., 2011); for diet and exercise support in weight control (Gerber, Stolley, Thompson,

Sharp, & Fitzgibbon, 2009; Hingle, Nichter, Medeiros, & Grace, 2013); for reminders to parents concerning immunizations (Ahlers-Schmidt et al., 2011); and for appointment reminders in a variety of patient populations (da Costa, Salomão, Martha, Pisa, & Sigulem, 2010; Perron et al., 2010). Several studies of texting during the prenatal period have shown mixed results with regard to diet management, weight control, and exercise (Cormick et al., 2012; Gazmararian, Elon, Yang, Graham, & Parker, 2014; Jordan, Ray, Johnson, & Evans, 2011). *TECHsex USA*, the whitepaper by Boyar, Levine, & Zensius, (2011) suggested that 93% of 13-24 year olds, described as youth and young adults, own cellular telephones and would like to receive sexuality and reproductive health information via private messaging services. Few studies using texting with pregnant adolescents have been conducted. Two studies with pregnant women, 18 years and older were identified, although the studies did not specifically address the adolescents. Cormick et al. (2012) studied cell phone access and usage, as well as health information needs of pregnant women in Argentina. They found the women were willing to be enrolled in a texting program and preferred messages from one to three times a week. A study by Jareethum et al. (2008) considered satisfaction with prenatal care in pregnant women over 18 years old when receiving text messages for support or not. Significantly higher satisfaction was found among the women receiving the text messages in addition to feelings of being supported. Pelletier, McDermott, Myint-U, and Kvedar (2012) utilized outbound text messages of educational tips, reminders of availability, and motivational support to augment prenatal care with patients 14-32 years. Participants

found the messages helpful and would recommend others enroll in the program. The authors did not address the adolescents separately.

Text4Baby, a national texting program for low income pregnant women, was established to provide educational information on a variety of topics relevant during pregnancy for mom and baby, during the postpartum period, and during the baby's first year (Jordan, Ray, Johnson, & Evans, 2011). Gazmararian, Elon, Yang, Graham, and Parker (2014) reviewed the *Text4Baby* program, focusing on enrollment and reception of the program. The authors found the program was well received and utilized by women with higher education, higher income, and smaller households although was not utilized as much in the lower education, lower income target population as had been hoped. In the *Text4Baby* program, the mother receives information about the site from the practitioner and then must sign up to begin receiving texts. Data collection is ongoing to identify usage and participant perceptions about the program. Jareethum et al. (2008) found that pregnant women had increased satisfaction with prenatal care when receiving short text messages. No studies were found related to texting prenatal appointment reminders. Texting appointment reminders have a positive effect on immunization appointment attendance for adults (da Costa et al., 2010; Perron et al., 2010) and children (Downer, Meara, DaCosta, & Sethuraman, 2006; Stockwell et al., 2012). No studies have specifically evaluated pregnant adolescents knowledge obtained from text messages. This study addressed the development of an educational text messaging tool for pregnant

adolescents, including an assessment of the content validity of the tool, and a pilot test of the tool/intervention.

Problem of Study

Pregnant adolescents tend to seek prenatal care late or not at all, miss prenatal appointments, gain too little or too much weight during pregnancy, and deliver low or high birth weight babies (CDC, 2000; CDC – Birth Weight, 2013; Harper et al., 2011; Ludwig & Currie, 2010; March of Dimes, 2011; Perron et al., 2010; Wilson et al., 2012). It is unclear if adolescents possess the knowledge about nutrition and physical activity to keep gestational weight gain within recommended guidelines. The author developed an educational text messaging intervention, utilized subject matter experts (SMEs) to assess the content validity of the intervention, and pilot tested the intervention for effect on pregnant adolescents' knowledge of nutrition and physical activity.

Multiple sources invested in prenatal care of women have identified and published nutrition and physical activity guidelines specific for pregnancy (Academy of Nutrition and Dietetics [AND], 2014; American Academy of Pediatrics [AAP] & American Congress of Obstetricians and Gynecologists [ACOG], 2007; US Department of Agriculture [USDA], 2011; Widen & Siega-Riz, 2010). Concerns have arisen regarding whether women are receiving the education needed to eat healthy and be active during their pregnancy. In a systematic literature review, Lucas, Charlton, and Yeatman (2014) found that adequate nutrition information was not given to women during their prenatal visits. Other authors reported that women state they know to eat healthy and

exercise but do not specifically know what to eat or what kind of activity to perform or where to get the information (Collins & Champion, 2014; Hearn, Miller, & Lester, 2014; Krans & Chang, 2012; Lucas et al., 2014; Reyes, Klotz, & Herring, 2013). Information focusing specifically on adolescent pregnancy and these concerns is scarce.

Rationale for the Study

Computers and other forms of information technology (IT) are utilized everywhere in education and the health care system. IT at the point of service is occurring with mobile computers and hand held devices, such as tablets/notebooks and mobile telephones, at the bedside (Garrett & Klein, 2008; White et al., 2005). Mobile health, or m-health involves the use of cellular phones to communicate, educate, support, and receive reports from patients (Stockwell et al., 2012). This method has been utilized with pregnant women for prenatal support (Jareethum et al., 2008), supporting regular exercise (Gerber et al., 2009), and maintaining a diet/weight control program (Woolford et al., 2010) with mixed results. A paucity of these studies exists with pregnant adolescents.

Pregnancy

According to Blackburn (2014), “the pregnant woman experiences dramatic physiologic changes to meet the demands of the developing fetus, maintain homeostasis, and prepare for birth and lactation” (p. 71). The nutritional status of the woman prior to pregnancy and during pregnancy support many of these changes and has an effect on outcomes, especially on the mothers’ gestational weight gain and the birth weight of the

infant. Age of the mother and prenatal care, or lack thereof, will also influence pregnancy outcomes.

Any girl, age 13-19, who becomes pregnant, is a pregnant adolescent. Most adolescent pregnancies occur in girls age 15-19. Adolescent pregnancies are in a higher risk group for many complications, including nutritional issues, weight loss, anorexia, excess weight gain, preterm labor, low birth weight infants, and stillbirth (CDC – Teen Pregnancy, 2013; WHO, 2012). During the second and third trimester the fetus is growing and finalizing development. This time period is important for weight gain for both the mother and the fetus. Too little or too much gain is reflected in the amount the infant weighs at birth. As obesity increases across the population, it has increased in adolescents and additionally, more infants are born in the high birth weight range (CDC – Birth Weight, 2013; Halfon & Lu, 2010; Harper et al., 2011; Ludwig & Currie, 2010).

Actively monitoring dietary intake and focusing on eating a balanced diet helps to control gestational weight gain. Implementing and following an exercise program also facilitates control of gestational weight gain (ACOG, 2002). The IOM has published guidelines for weight gain during pregnancy which are based on the pre-pregnant BMI with a weight gain range specific to that BMI. Adolescents who are pregnant are included in these guidelines based on BMI.

Prenatal care is important in the health care of the pregnant woman and the growing fetus and has been shown to influence pregnancy outcomes (U.S. Department of Health and Human Services, 2010). The ongoing physical and hemodynamic assessment,

education, and communication that occurs all play a role in this time of care. Pregnancy has been described as a teachable moment by Phelan (2010), where this natural life transition is thought to motivate adoption of risk-reducing behaviors. The foundation of this concept is found in behavior models. Adolescents typically start prenatal care later than adults (March of Dimes, 2011) or have no prenatal care (CDC, 2000). The more prenatal appointments missed the greater the chance that excess weight gain or loss, complications, or other problems can occur without timely identification and intervention (Debiec et al., 2010; Simpson & Creehan, 2014). Practitioners are trying new methods to engage pregnant women, especially pregnant teenagers in all aspects of prenatal care (appointments for monitoring, nutrition and physical activity education).

Mobile Health

Mobile wireless devices, such as mobile telephones or smart phones, are ideal tools for enhancing teaching and learning (Maginnis, White, & Mckenna, 2000). With wireless mobile devices, people are able to connect to information anytime and anywhere. This concept in learning has begun to move into health care education. The use of mobile telephones by the health care consumer or patient is changing how health care is delivered. This process of using mobile technology to enhance patient health and health care delivery is called m-health.

The International Telecommunication Union (2013) estimates there are about 6.8 billion mobile subscriptions worldwide, which is equivalent to 96% of the world population. It is estimated that in the developed world, the saturation point is rapidly

approaching with at least one mobile subscription per person. As of 2011, the Pew Research Center stated “83% of American adults own cell phones and three-quarters of them (73%) send and receive text messages” (p. 2). Texting occurs more frequently in young adults and tends to level off in the adult population. The number of teens texting is on the rise with approximately 75% of all teens now hitting the keys. Teens aged 14-17 have increased the most since 2009 and girls are more connected than boys (Pew Research Center, 2012).

It is logical to extend the arm of m-health into the public/patient arena, with this increased number of adults and adolescents using cellular telephones. Studies calling patients to follow up on care or for support have been conducted for several years. In the last 6-10 years there have been more studies implemented utilizing texting to support a patient while on a diet or exercise regimen, in the management of disease processes and to increase attendance at appointments. Most of these studies have been in the adult population. Some of these studies have been geared toward adolescents, children and their parents (Ahlers-Schmidt et al., 2011; Ahlers-Schmidt et al., 2012; Coker et al., 2010; Stockwell et al., 2012). Woolford et al. (2010) focused on text messages with adolescents as an additional method in treating obesity. Other approaches were addressed in the study by Hingle et al. (2013) with the development of healthy lifestyle messages. This focus on healthy lifestyle development is an area where mobile technology may make a difference. The ability to reach adolescents with short timely text

messages about healthy behaviors and choices could act similar to an inoculation booster in improving health.

Modifying human behavior requires understanding the components that result in a successful alteration of behavior. Identifying the method that creates the modification is the key to duplicating the behavior. Bandura's Social Cognitive Theory [SCT] (1986) explains this process.

Theoretical Framework

Bandura's Social Cognitive Theory (1986) was utilized as the theoretical framework for the pilot study. Social Cognitive Theory, (SCT) describes a framework for understanding, predicting, and changing human behavior which consists of an interaction of personal, behavioral, and environmental factors (Bandura, 1977, 1986, 2004). SCT supports the belief that an individual can shift their perspective as he/she moves from thinking to acting. SCT, at its core, considers individuals as agents with the ability to control, at some level, their own behavior and environmental events (Bandura, 1997). According to Bandura (1997), effectively controlling behavior requires coordination of knowledge, skills, and resources to manage changing situations.

Social cognitive theory identifies a relationship among three factors that relate to how individuals acquire and maintain health-related behaviors: personal characteristics, environmental events (social and physical), and personal experiences (behavioral) (Bandura, 2004). Each of these factors influence the others in an interlocking manner that can go in any direction. The constant interaction between person, behavior, and

environment involving the triadic reciprocal determinism is central to understanding how SCT functions. These reciprocal interactions between person, behavior, and environment are not necessarily equal in strength or simultaneous, and differ based on the individual. One causal factor may exert a greater influence quickly or slowly. Behavioral changes can facilitate greater self-evaluation, which then increases levels of perceived self-efficacy and modifies outcome expectations, and personal beliefs, thus influencing future behavior (Bandura, 2004).

In the pilot study, SCT was actualized when reciprocal interactions occurred between personal, behavioral, and environmental factors as described below. The first interaction occurs between personal factors (preferences, cognitive and affective, beliefs, actions) and behavioral factors (capability, actions, habits, having knowledge). In the study, this interface occurs when the pregnant adolescent with beliefs or actions about nutrition and physical activity during pregnancy identifies capability or knowledge of nutrition and physical activity when answering the pretest questionnaire. The second interaction occurs between personal and environmental factors (physical and sociocultural events) which includes the beliefs and cognitive competencies modified by social and environmental events. In the study, this interface was demonstrated as the personal factor, participants' preferences and beliefs, were modified or not by the environmental factor, support/educational text messages received. The third interaction occurs between environmental factors and behavioral factors where behavior determines and is then modified by the environment as well as the environment influences the

behavior. In the study, this interface was influenced by the participants behavior (prior capability, actions, and knowledge of nutrition and physical activity) influencing their environment of receiving the supporting educational text messages and utilizing the information, then responding back into the environment by potentially changing their behavior resulting in a change in their posttest questionnaire scores. The following diagram shows how the variables in the study was applied within the SCT model. (Appendix A).

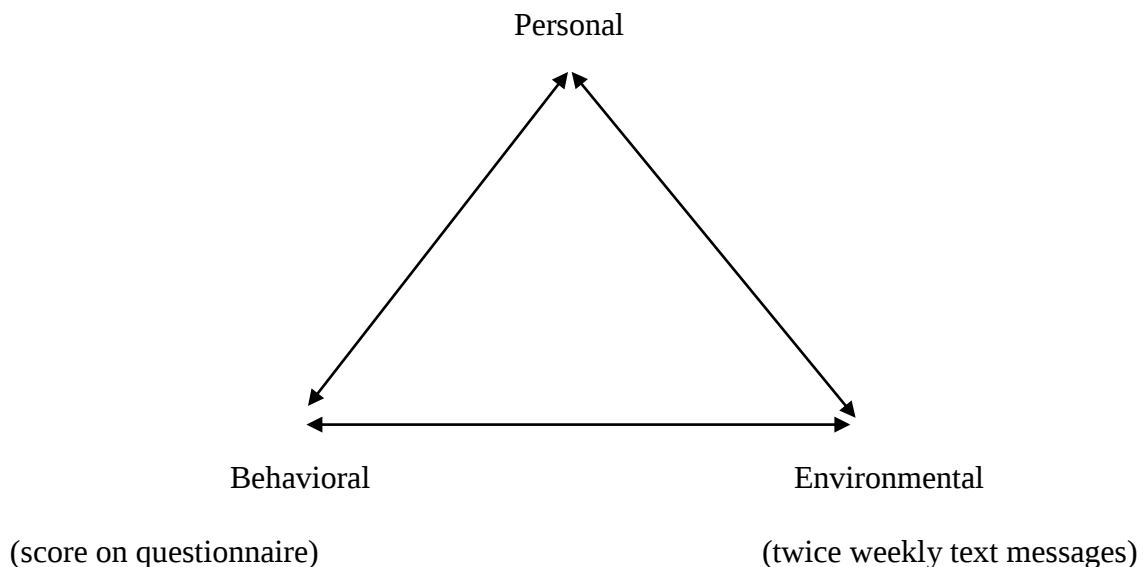


Figure 1. Social Cognitive Theory Model

Assumptions

The assumptions for this study are:

1. Learning is an internal process that may or may not change behavior (Bandura, 1997).
2. Behavior is directed toward particular goals (Bandura, 1997).

3. There is a triangle of reciprocal causality among personal, behavioral, and environmental influences (Bandura, 1997).
4. A change in the pretest posttest score indicates increased knowledge.

Research Question and Hypotheses

Two questions guided this study: 1) what is the content validity of the researcher developed text messaging intervention, 2) how does an educational text message intervention influence pregnant adolescents' knowledge of nutrition and physical activity?

Definition of Terms

The following terms are conceptually and operationally defined within the context of this study.

Adolescent Pregnancy

Conceptual definition. Adolescence is the time period between 10-19 years (WHO, 2012). Adolescent pregnancy is any pregnancy after menarche through the age of 19 years (Okogbenin & Okpere, 2004).

Operational definition. Girls age 16 to 19 years old, who are pregnant.

Text Messages

Conceptual definition. "An electronic communication sent and received by cellular phone" (Oxford Online Dictionary, 2014).

Operational definition. An educational message, sent via cellular telephone twice a week on Monday and Thursday at 4 p.m. A different message will be sent each

time addressing the topics of nutrition or physical activity during pregnancy. (Appendix B)

Knowledge

Conceptual definition. “facts, information and skills acquired by a person through experience or education” (Oxford Online Dictionary, 2014). “the range of one’s information or understanding” (Merriam Webster Dictionary, 2014).

Operational definition. Knowledge of nutrition and physical activity in the participants will be measured by the Family Nutrition & Physical Activity (FNPA) screening tool developed by Ihmels and Welk (Ihmels, Welk, Eisenmann, & Nusser, 2009) from Iowa State University in collaboration with the American Dietetic Association. There are 20 items on the tool, which are rated on a 4-point Likert-type scale. The options are: almost never, sometimes, usually, and almost always, with a possible score of 20-80. Higher scores indicate a lower risk for being overweight or at risk of overweight. (Appendix C)

Delimitations and Limitations

The two delimitations to this study were (a) the study was conducted in one geographic area in the South-Central United States, and (b) the sample was limited to 16-19 year old adolescents who are pregnant. The findings of this study were only generalizable to these study participants. The two limitations to this study are (a) self-selection: pregnant adolescents who chose to participate may be different from those who

chose not to participate; and (b) recruitment sites: recruiting participants from only one site might result in the participants not being representative of other groups.

Summary

The use of technology is increasing in our everyday lives; in education, at work, and in our homes, regardless of our position or profession. A nurse must be prepared with the knowledge and the interest to implement technology in the care of patients in the clinical setting, especially with pregnant adolescents. Mobile technology has exploded worldwide and has been used for years in health care, where it is called m-health. Adolescents have been shown to be among the top users of mobile technology in the U.S. Several studies have utilized mobile telephones to remind patients of appointments, exercising, taking medications, following a specific diet and for general health care support. Some have shown significant results and some have not. Adolescents, especially pregnant adolescents, have been the subject of very few studies. This study attempted to address the gap in knowledge of nutrition and physical activity recommended for pregnant adolescents through the development and validation of an educational text messaging tool. A pilot study to test the influence of the tool was also conducted.

CHAPTER II

REVIEW OF THE LITERATURE

The following literature review will address the information available regarding the practice of prenatal care in pregnant adolescents; specific outcomes and knowledge of nutrition and physical activity related to pregnant adolescents; and the utilization of m-health, specifically texting, in their care. This review of the literature will discuss (1) pregnancy, including infant birth weight, and adolescent pregnancy, (2) gestational weight gain, (3) prenatal care, including knowledge of nutrition and physical activity, and (4) mobile phones and mobile health, specifically text messaging with adolescents and pregnant women. A gap in knowledge was demonstrated as it relates to the knowledge of nutrition and physical activity in pregnant adolescents and the use of text messages as an intervention with adolescents during pregnancy. The proposed study, developing and testing an educational text message tool for pregnant adolescents, addressed the identified gap in the literature.

A structured search of the literature was conducted utilizing the following databases: Academic Search Complete, CINAHL plus, Science Direct, Scopus, PubMed, and digital dissertation. In addition, the references of articles were reviewed for possible research. Key search words were pregnant adolescent, teen pregnancy, and adolescent pregnancy combined with weight gain, gestational weight gain (GWG), infant birth

weight, nutrition in pregnancy, physical activity in pregnancy, prenatal care, m-health, text messaging, and text messages in healthcare.

Pregnancy

According to Blackburn (2014), “the pregnant woman experiences dramatic physiologic changes to meet the demands of the developing fetus, maintain homeostasis, and prepare for birth and lactation” (p. 71). Some of these changes, such as increased blood volume and fluid retention result in weight gain throughout pregnancy called gestational weight gain. The nutritional status of the woman prior to pregnancy and during pregnancy support many of these changes and has an effect on outcomes, especially on the mothers’ gestational weight gain and the birth weight of the infant. The amount of gestational weight gain has been shown to have an influence on the infant’s birth weight (Barger, 2010; Chung et al., 2013). Infant birth weight is described in terms of low birth weight (LBW) (less than 2500 grams), high birth weight (HBW) (greater than 4000 grams), or average (between these extremes). Infants born in the low birth weight category frequently experience complications, such as respiratory difficulty, eating difficulty, and temperature stabilization, and may require extended stays in the hospital (CDC, 2013 Birth weight; WHO, 2012). Infants born in the high birth weight category also frequently experience complications, such as broken clavicle, shoulder dislocation, facial nerve damage, and traumatic delivery (use of vacuum, forceps, or cesarean birth) (CDC, 2013 Birth weight; WHO, 2012). Age of the mother and prenatal care, or lack thereof, will also influence pregnancy outcomes.

Teenage or adolescent pregnancy is when a pregnancy occurs in a girl from 13-19 years of age (UNICEF, 2008). Greater numbers of pregnancies occur in later adolescent years than in the earlier years (CDC, 2000; Martin et al., 2013; WHO, 2012). An adolescent who is pregnant progresses through the same changes in her body as any pregnant woman, in addition to the issues related to being a teenager. Pregnant adolescents are at higher risk for many complications, including nutritional issues, weight loss, anorexia, excess weight gain, preterm labor, and low birth weight infants (Barron, 2014). During the second and third trimester the fetus is growing and finalizing development. This time is important for weight gain for both the mother and the fetus. Too little or too much gain is reflected in the amount the infant weighs at birth. Low birth weight infants have been a problem for adolescent mothers for many years (Markovitz et al., 2005; Wilson et al., 2012). In addition to preterm deliveries, low birth weights among adolescents have been a major focus of the March of Dimes over the years. Now, with the increased amount of obesity in the general population in children and through adulthood, there are increasing numbers of high birth weight infants (Harper et al., 2011).

Pregnancy outcomes are enhanced in women, including adolescents, who receive early and regular prenatal care, such as medical and psychosocial support, resulting in healthier infants (AAP & ACOG, 2007; Hofmeyr & Hodnett, 2013; Kirkham, Harris, & Grzybowski, 2005). Adolescents, who are often concrete thinkers, may not always plan ahead, which may lead to missed prenatal appointments. Pregnant adolescents often struggle with weight, with either gaining too little or too much. Often the adolescent

delivers her infant prematurely and/or with low birth weight (CDC, 2013; Halfon & Lu, 2010; Harper et al., 2011).

In summary, pregnancy is a time of rapid changes in the woman's body that facilitate development of the fetus. This is a critical time to be monitoring these changes and potential complications (AAP & ACOG, 2007). Gestational weight gain is expected to occur although too much or too little causes changes in the infant's birth weight (IOM, 2009).

Gestational Weight Gain

Researchers have been exploring how gestational weight gain affects maternal and fetal outcomes. Several studies focused on implementing Institute of Medicine (IOM) guidelines while others examined the GWG and birth weight. These studies are addressed below.

After nearly twenty years without revision, the GWG guidelines were revised by the IOM in 2009. During the time span from the last revision, the pregnancy weight and GWG trended up and outside the 1990 IOM guidelines (Siega-Riz, Deierlein, & Stuebe, 2010). The first change was the adoption of the International Obesity Task Force (IOTF) BMI categories of underweight (<18.5), normal weight ($18.5-24.9$), overweight ($25.0-29.9$), or obese (≥ 30). The WHO has also implemented these categories, which integrate adolescents (<18 years) into each category, based on their BMI rather than having a separate category where they are treated specially, as with previous guidelines. The second change was in the continued ranges for suggested GWG based on pre-pregnant

weight; underweight female (28-40 lb.), normal weight female (25-35 lb.), and overweight female (15-25 lb.), plus an additional narrow range for obese female (11-20 lb.). In these guidelines, pregnant adolescents do not have separate ranges, but are included according to their weight.

The IOM (2009) based the new guidelines on research of gestational weight gain and fetal outcomes. Because of this consideration, the guidelines for obese women were not lowered. With decreasing gestational weight gain, a rise in preterm births and risk of small for gestational age (SGA) infants is seen in all women (IOM, 2009). A weight loss or low gain, resulting in altered ketone levels and other physiological changes has the potential for irreversible neurologic changes (such as poor school performance) in the fetus of obese women (Rasmussen et al., 2010).

According to Siega-Riz, Deierlein, and Stuebe (2010) in their review of the 2009 IOM guidelines, it is believed women will gain over the suggested guidelines and an “intervention to improve dietary intake and physical activity are necessary to achieve the targeted weight gains” (p. 513). The guidelines are to provide a goal for the woman and fetus to keep weight gain on track, continue to exercise and eat fruits, vegetables, whole grains, and lean meats. It is believed by the authors that a radical change in prenatal care will be required and health care providers will be major change agents.

Harper, Chang, and Macones (2011) conducted a retrospective study to examine the IOM gestational weight gain guidelines in adolescents and outcomes for SGA infants, LGA infants, preterm delivery, infant death, preeclampsia, cesarean and operative vaginal

delivery. This retrospective cohort study reviewed the Missouri birth, fetal, and infant death certificate data from 1989-2005. The sample included 76,682 primiparous women under 20 years old who delivered singleton pregnancy from 24-44 weeks of gestation. The Pearson chi-square test (χ^2) for categoric variables and *t* test for continuous variables were used to assess the differences in sample characteristics by BMI categories. Binary logistic regression was used to estimate odds ratios (ORs) and the 95% confidence interval (CI). Tests were 2-tailed and a $< .05$ probability value was considered significant.

Most of the adolescents in the study were 17-19 years old. The authors reported, “For every BMI category, the odds of having a SGA baby decreased as gestational weight gain increased” (Harper et al., 2011, p. 140.e3). Incidence of SGA in subjects who gained within the guidelines for obese subjects was 14.23%, underweight subjects 18.51%. “Although the rate of LGA infants increased 2- to 2.5-fold in adolescents who gained more than the IOM recommendations compared with those gained within the recommendations” (p. 140.e3). Results showed 11.84% for obese adolescents, and 7.66% for underweight adolescents who gained greater than the guidelines. Ultimately, “the absolute rate of LGA infants did not exceed 10%, except for obese adolescents who gained more than the IOM recommendations” (p. 140.e3).

Durie, Thornburg, and Glantz (2011) conducted a retrospective cohort study examining the effect of GWG during the second- and third-trimester on maternal and fetal outcomes. The 2009 IOM revised guidelines were used for the classification groups. The guidelines included recommended rates of weight gain for the second- and third-

trimester broken into pounds per week: underweight, 1-1.3 lb.; normal weight, 0.8-1 lb.; overweight, 0.5-0.7 lb.; and obese, 0.4-0.6 lb. The sample included 73,977 women with singleton births in a region of New York from 2004-2008. The study examined prepregnant BMI, rate of weight gain during the second- and third-trimester, and maternal and neonatal outcomes.

To assess the differences in demographic and GWG aspects, Chi-square analysis and analysis of variance was utilized for categorical and continuous variables respectively. Statistical significance was set at $P < .01$ with 99% confidence interval. To determine the effect of the rate of weight gain on pregnancy outcomes, the authors performed a backward logistic regression analysis within each BMI class (Durie et al., 2011).

Results indicated “less than recommended rates of second- and third-trimester weight gain were associated with increased odds of small-for-gestational-age neonates in all BMI groups except obese classes II and III” (Durie et al., 2011, p. 569). Further, “greater than recommended rates of weight gain were associated with increased odds of large-for-gestational-age neonates in all BMI groups” (p. 569). The authors concluded that in all groups except obese, less than recommended and more than recommended gestational weight gain resulted in unfavorable pregnancy outcomes. Particularly, “nonobese women with suboptimal rates of weight gain have increased odds for small-for-gestational-age neonates, a finding not seen in the most obese women” (p. 574).

Lastly, large-for-gestational-age neonates were associated with excessive rates of weight gain regardless of BMI.

GWG has an effect on infant birth weight with the greatest affect seen in excessive maternal weight gain. Managing GWG is important for the health of the mother and the infant. Actively monitoring dietary intake and focusing on eating a balanced diet helps to control gestational weight gain. The American Congress of Obstetricians and Gynecologists (ACOG) suggest implementing and following an exercise program also facilitates management of gestational weight gain (2002). Several studies have examined exercise and diet on weight control.

Ruchat et al. (2012) studied the effect of two different exercise intensities with added nutritional intake control, on gestational weight gain, infant birth weight, and postpartum weight retention. The sample included 49 normal weight women 18-40 years old, with singleton pregnancy of 16-20 weeks gestation who were randomized into moderate-intensity (MI) (N=26) and low-intensity(LI) (N=23) exercise groups. The intervention groups walked at their target heart rate for 30 minutes three to four times a week, and to control nutritional intake they followed a modified gestational diabetes meal plan.

A chi-square test was performed with multiple variables: on percent of women who had excessive pregnancy weight gain comparing the two intervention groups; on percent of women who retained less than or equal to two kilograms at two months postpartum; and on percentage of infants born weighing less than 4000 grams versus

greater than or equal to 4000 grams and less than 2500 grams versus greater than or equal to 2500 grams. Analysis of variance (ANOVA) was utilized to evaluate the effect of the intervention on infant birth weight. A primary analysis of covariance (ANCOVA) was performed to evaluate the effects of intervention on GWG and weight retention, and a secondary analysis with the control group versus LI versus MI was performed.

The groups participated for a mean of 21.5 weeks plus or minus 2.0 weeks duration and number of sessions was not different between the groups “(LI = 36 ± 17 sessions, MI = 44 ± 26 sessions, $P = 0.20$)” (Ruchat et al., 2012, p. 1422). No difference between the groups was found with dietary recall analysis. Similar weight gain during pregnancy was found in the intervention groups ($P = 0.72$; 15.3 ± 2.9 and 14.9 ± 3.8 LI and MI respectively). The control group had a greater weight gain during pregnancy (18.3 ± 5.3 kg) when compared with the intervention groups. Infant birth weight was similar between all three groups, with only one baby weighing less than 2500 grams at full term (in MI group).

In summary, low to moderate intensity exercise and nutritional control were beneficial in preventing excessive weight gain. An increase in exercise intensity did not show increased benefits in either weight gain or infant birth weight.

Hui et al. (2012) conducted a randomized controlled trial to study the effect of exercise and dietary intervention on excessive gestational weight gain. The sample of 190 pregnant women, less than 26 weeks gestation were randomly assigned to the control and intervention groups. The intervention consisted of a community based exercise program

with a variety of exercises such as walking, mild to moderate aerobic, stretching and strength exercises. The group exercised three to five times a week for 30-45 minutes per session. The dietary aspect of the intervention included an interview and counselling to the group twice, at enrollment and at two months.

The Student's *t* test was utilized for demographic variables and Bonferroni correction for data with multiple variables. A chi-square test was utilized to assess the prevalence of excessive gestational weight gain (EGWG), gestational diabetes mellitus, and large-for-gestational-age infants.

There were no significant differences in diet at baseline although the intervention group at two months had significantly lower total calorie, fat, saturated fat and cholesterol intake compared to the control group ($P = 0.00004-0.002$). In addition, no significant differences were found between groups in the baseline physical activity. The levels of physical activity were significantly higher in the intervention group at two months compared with the baseline ($P = 0.0001$) and with the control group at two months ($P = 0.00002$). No significant differences between groups in infant birth weight or prevalence for LGA infants were found. Although there was no significant difference of weight gains between the groups (control: 15.2 ± 5.9 kg and intervention: 14.1 ± 6.0 kg), the intervention group had significantly lower prevalence of EGWG (35.3%) compared to the control (54.5%) “(chi-square 7.10, 95% CI 0.47-0.90, $P = 0.008$)” (Hui et al., 2012, p.75). In summary, the intervention group demonstrated a significant

reduction of EGWG with the exercise program and dietary intervention compared to the control group.

Thangaratinam et al. (2012) conducted a meta-analysis of 44 studies of lifestyle and dietary interventions and GWG. The results indicated the ability to reduce maternal GWG and improved maternal and infant outcomes when lifestyle and dietary interventions were implemented. The authors stated “Among the interventions, those based on diet are the most effective and are associated with reductions in maternal gestational weight gain and improved obstetric outcomes” (p. 1).

In summary, these studies support the idea that the GWG affects the infant birth weight. It is recommended that weight gain be within the established IOM guidelines. Watching diet and mild-to-moderate exercise helps control excessive GWG. It is unclear if pregnant adolescents have knowledge about nutrition and physical activity to keep GWG within the established IOM guidelines.

Prenatal Care

An important aspect of any pregnancy is monitoring that occurs throughout the pregnancy. Prenatal care, “a comprehensive antepartum care program involves a coordinated approach to medical care and psychosocial support that optimally begins before conception and extends throughout the antepartum period” (American Academy of Pediatrics [AAP] & ACOG, 2007, p. 112). This prenatal monitoring is vital to assess the mothers’ weight gain or loss, growth of the fetus, laboratory results, vital signs, and risk of complications (AAP & ACOG, 2007; Gilbert, 2011; Kirkham et al., 2005).

Adolescents typically start prenatal care later than adults (March of Dimes, 2011) or have no prenatal care (CDC, 2000). Starting prenatal care late, after the first trimester, reduces the total time available to monitor the health of the mother and the fetus. A missed appointment is another missed opportunity to monitor the health of mother and fetus. According to the National Guideline Clearinghouse and the Institute for Clinical Systems Improvement, evidenced-based recommendations have been established for prenatal care of at least eleven visits (Akkerman et al., 2012). The suggested timing for visits is to have the first visit by 10 weeks gestation and then approximately every four weeks until 28 weeks, then every 2-3 weeks until 36 weeks and then weekly thereafter. The more appointments that are missed the greater the chance that excess weight gain or loss, complications, or other problems can occur without timely identification and therefore intervention (AAP & ACOG, 2007; Debiec et al., 2010; Kirkham et al., 2005). The increasing focus on improving perinatal outcomes, with the United Nations *Millennium Development Goals* (2000) and the *Healthy People 2020* (2010) objectives has caused obstetric health care practitioners to seek new or additional methods to increase patient care. The use of technology has been increasing in all areas of health care for over 10 years, with rapid movement into the outpatient population.

“Inadequate prenatal care is strongly associated with preterm birth among adolescents” (Debiec et al., 2010, p. 122.e1). A retrospective study was conducted to establish if inadequate prenatal care among adolescents was associated with increased preterm birth. The random sample of 27,107 women under 20 years of age with singleton

births were selected from the Washington State birth record data from 1995-2006. The authors based adequate prenatal care on the American College of Obstetrics and Gynecology guidelines: first prenatal visit through 28 weeks – every 4 weeks, 28-36 weeks – every 2-3 weeks, and weekly till delivery.

To test for differences in demographics, reproductive, and behavioral variables across the prenatal care categories a one-way ANOVA and Chi-square test were utilized. To assess the association between prenatal care and preterm birth a univariate logistic regression was utilized. “For teens with no prenatal care, 24.1% of births were preterm, compared with 3.9% preterm births with 75-100% of visits and 10.5% preterm births for more than 100% of visits” (Debiec et al., 2010, p. 122.e2). No prenatal care was associated with almost an eight times greater risk of preterm birth (OR, 7.9; 95% CI, 6.1-10.3) compared with 75-100% prenatal care visits. Risk decreased as prenatal care increased except with greater than 100% recommended visits where preterm birth was higher (OR, 2.9; 95% CI, 2.6-3.3). Increased risk of preterm birth was also associated with delayed initial prenatal care visit. This robust study indicates a higher risk for preterm birth in adolescents with no prenatal care or less than 75% of expected prenatal care visits. Healthcare practitioners should increase efforts to initiate early and continuous prenatal care with pregnant adolescents.

These studies verify the importance of prenatal care in the health care of the pregnant woman and the growing fetus. The ongoing physical and hemodynamic assessment, education, and communication that occur all play a role in this time of care.

Adolescents typically have delayed, infrequent, or no prenatal care. The more prenatal appointments that are missed, the greater the chance that excess weight gain or loss, complications, or other problems can occur without timely intervention.

Knowledge of Nutrition and Physical Activity

Appropriate knowledge of nutrition and physical activity is encouraged during pregnancy as an important aspect of the education received throughout prenatal care. The specific choices encouraged for healthy nutrition and physical activity during pregnancy, which vary some from the general population, can be discussed early to promote healthy lifestyle choices, resultant gestational weight gain and pregnancy outcomes (Academy of Nutrition and Dietetics, 2014). The Academy of Nutrition and Dietetics (AND) states in their position paper “Components leading to a healthy pregnancy outcome include...consumption of a wide variety of foods, appropriate vitamin and mineral supplementation, avoidance of alcohol and other harmful substances, and safe food handling” (p.1099, 2014). Evidence increasingly demonstrates long-term health of children is influenced by maternal diet intake and lifestyle choices.

Pregnant women, especially adolescents should have an adequate intake of foods containing folic acid and iron as well as calcium, iodine, choline, and vitamin D. The consumption of fish during pregnancy has been a carefully balanced benefit versus concern recommendation. The n-3 fatty acid intake is recommended for the benefit to the fetus while the possibility of mercury in fish is a concern. Other substances to avoid during pregnancy are alcohol, caffeine (no more than 200 mg per day), energy drinks,

and sugar-sweetened drinks. Hydration is important and essential during pregnancy with plenty of water recommended, 3 L/day (AND, 2014).

Therefore, encouraging sufficient maternal nutrition to provide appropriate health while supporting a healthy uterine environment for optimal fetal development is a goal of prenatal nutrition and education. Engaging a healthy lifestyle during pregnancy would include regular physical activity and prenatal nutrition which avoids over consumption for mother and under nutrition for the fetus.

Collins and Champion (2014), conducted a pilot study with rural Mexican American adolescents (RMAA) to assess the use of text messages for information about diet and exercise. The aim of the study was to describe how the internet and text messages via mobile phones were used to gain knowledge about diet and exercise. The authors felt “evaluating the use of mobile devices for diet and exercise knowledge will provide evidence for its potential use in a comprehensive, multi-factorial, multi-component intervention to address over-weight and obesity in this community” (p. 494).

A convenience sample of adolescents was recruited during routine visits at the rural health clinic. Additional participants were recruited utilizing the snowball sampling method. The sample included identifying as Mexican American, 12-18 years of age, obtained parental consent and participant assent. Each participant was paid twenty dollars for participation in one of three focus groups. Six questions guided the focus groups by addressing what they know about diet and exercise; describing obesity in their area; answering if they use mobile devices for health information, to find information about

diet and exercise, to make health changes, or to help friends (Collins & Champion, 2014). The data from the groups were analyzed using open coding in which broad categories were developed. The content was further grouped into sub-categories as the “authors had ongoing discussions of categories and sub-categories to maintain rigor in the study design” (p. 495). Four categories evolved from the data 1) knowledge of diet information; 2) resources for diet and exercise information, with sub-categories of peers, adults, mobile devices, and SMS; 3) who becomes overweight and why; and 4) avoiding being overweight, with the sub-categories of comparisons, exercise now - diet later, and women: you’re overweight, go do something! (Collins & Champion, 2014).

In the first category of knowledge of diet information, participants identified food as good or bad. Specific comments made by males in the groups included “Lasagna would be good” and “French fries are bad because they’re like fried it’s all saturated with grease” (Collins & Champion, 2014, p. 496). Females commented “vegetables are better than chips, you know”, “get on a good diet, 3 meals a day, healthy meals, balanced meals”, and “salads, apples” (p. 496).

The second category, resources for diet and exercise information yielded participant comments further grouped into subcategories. Comments in the sub-category peers were made by only males and related to exercising in the summer with peers such as “probably wouldn’t do it by myself either” (Collins & Champion, 2014, p. 497). In the sub-category adults, comments by the males mentioned coaches and a sports medicine teacher as resources on food and exercise information and support. Females mentioned

mostly parents and health care provider as resources. In the mobile device sub-category males mentioned the internet was used to seek information regarding muscle building but not for diet in one group, while in another group diet information was searched. Males commented that SMS was used to arrange exercise and if they were to receive suggestions about what to eat through texts one commented he would “delete it”, then changed to “maybe I think I would probably try it” (p. 497). The females commented on using the internet as a resource through online advertisements, social media (like Facebook), and internet radio sites. The females commented they would be receptive to receive SMS texts and use internet tracking progress.

The third category, developed with comments from males as to who becomes overweight and why, focused on after high school or during high school. After high school comments related to eating the same and not exercising any more, while during high school comments focused on not being involved in a sport leading to being overweight. Comments from females centered on home such as “sit at home and do nothing, couch potatoes” (Collins & Champion, 2014, p. 497).

The final category, avoiding being overweight also resulted in subcategories. In the sub-category, comparisons, comments from males were compared to other males such as “You don’t want to be a fat guy” and “You don’t want to end up like that” (Collins & Champion, 2014, p. 498). Females comments were also compare to other females regarding being too large and too small, “Like I don’t want to go overboard”. In the sub-category of exercise now, diet later the comments were all from males. Most of the

comments indicated they did not watch what they ate or keep track, nor did they pay attention to information in newspapers or on TV, stating “I don’t really pay attention” and “I fast-forward through them” (p. 498). In the sub-category women: you’re overweight, go do something! The females commented that messages in the media were ignored stating “Because it’s not really what anybody wants to hear” and “That you’re overweight! You’re overweight, go do something!” (p. 498). Additionally, they felt more pressure for women to be thin than men stating “Because you just want to look like all the models and stuff” and “Like everybody thinks they’re fat, because that’s the way they’ve been living for years” (p. 498).

In conclusion, Collins and Champion (2014) identified that adolescents applied diet and exercise information to themselves based on both community interaction and use of mobile devices stating “The use of mobile devices is one tool in a process of gathering data, comparing against others and self, and listening to others” (p. 499). Limitations of the study were the convenience sampling which may be biased toward rural participants, those not on athletic teams, or do not own mobile devices. The small sample size in addition to the lack of saturation of themes limits the application to other populations. Specifically more females and more adolescents not in athletics are needed as participants for validation of findings. Clinical implications include the “need to assess the potential use of mobile devices to transmit diet and exercise information within the context of adolescents’ existing levels of knowledge, understanding and social support” (p. 500). Further, “these devices may enhance and promote dialogue of existing knowledge and

practice” (p. 501), although cannot replace the existing community. Therefore, mobile devices and SMS may be utilized more efficiently to connect adolescents and community members rather than as the sole point of contact.

Hearn, Miller, and Lester (2014) conducted a study “to determine online information needs of perinatal women regarding healthy eating, physical activity, and healthy weight during pregnancy and the first eighteen months postpartum” (p. 2). The participants were recruited from pregnant women attending hospital antenatal clinics in Western Australia (WA) (intercept interview with 53 participants), postnatal mothers attending WA urban and rural playgroups (twelve focus groups with a total of 67 participants), and perinatal healthcare providers (PHCP) (intercept interviews with 76 to determine what information mothers should receive). The interview questions sought

- Information on maternal use of online devices and resources for lifestyle information during pregnancy and early postnatal months,
- Identification of main online resources used to seek information,
- Usefulness of online information,
- Amount/format of information sought,
- Source of online information sought,
- Gaps in useful forms of online information, and
- Preferred formats for presentation (p. 2).

After review of the transcripts using logico-inductive analysis and evaluation

of current online resources, the results were presented to the WA stakeholders and healthcare practitioners to determine how to best meet the needs of parents through online techniques. The outcome that evolved was the “development of a clinically endorsed Ngala Healthy You, Healthy Baby (HYHB) website and app (<http://www.ngala.com.au/hyhb>)” (Hearn et al., 2014, p. 3). Mothers were referred by general practitioners, obstetricians, midwives, and child health nurses to use the website and app. After one year of operation, Google Analytics provided resource usage data and demographic information of users which was analyzed and compared to birth statistics.

Results were separated into six categories for discussion. The first category discussed was *Mothers and PHCPs online needs and preferences*. The participants stated finding quick, short, fact based answers to their immediate concerns without having to visit the health practitioner for a non-medical reason was the biggest reason for utilizing the internet. Basically confirming knowledge and providing reassurance. Examples of information desired included “nutrition and diet, exercise, managing weight gain, sleeping problems, emotional fluctuations, allergies, breastfeeding, and gestational diabetes...realistic exercise they could do...quick, cheap, safe recipes they could easily prepare” (Hearn et al., 2014, p. 3). Further the participants expressed a desire for credible, evidenced based information although many were not satisfied with what is currently available online. The PHCPs identified the need for “positive messages to women about adopting healthy lifestyle changes at this crucial time in life to reduce potential complications” (p. 3). Further they identified the “need to recommend simple,

inexpensive foods and activities” (p. 3) useful across perinatal and postnatal periods for mothers and children.

The second category, *Gaps in online resources* discussed the scoring of government and private websites. Government websites had high scores on quality and quantity while scoring “low for parent focused, user friendly advice” (Hearn et al., 2014, p. 4). Private enterprise websites scores were flipped with low scores for quality and trustworthy information and high for parent engagement and detailed perinatal health needs information. Only one website reviewed included “interactive information for self-assessment, personalized advice, tracking of progress, or links to phone apps” (p. 4) and this website was not supported clinically.

The third category, *Development of a tailored, personalized online resource*, resulted in the integration of a new website *Healthy You, Healthy Baby* on the leading early childhood support organization Ngala (<http://www.ngala.com.au>). The site is clinically supported and designed with the requested information from the analysis, including interactive capability online and on the app.

Category four, *App and website overall usage* discussed the data obtained from Google Analytics after the first year of operation and then compared with birth statistics. The authors extrapolated “7% of pregnant WA women and 18% of first time mothers [were] using the app” (Hearn et al., 2014, p. 5). Data showed increased website user views (72% antenatal and 14% postnatal) and signups from first to second six months of operation and increased app use of 47%. Traffic to the parent website also increased after

beginning the HYHB site and app with “one quarter of the website traffic ...directly referred from the app” (p. 5).

App self-assessment and website content usage, the fifth category discussed the results of the first years data collected. The HYHB self-assessment apps were popular with the average user completing 3.6 questionnaires. The highest use time frame was during the first two trimester’s antepartum and first three months postpartum. During the first year, the most popular assessments completed “were weight (25%) and sleep (18%), followed by nutrition (15%), physical activity (15%), emotions (13%), and social life (13%)” (Hearn et al, 2014, p. 5). Further, highest views on the website pages concerning antepartum were related to “nutrition content (40% of views), followed by weight (33%), physical activity (14%), sleep (6%), emotions (5%), and social life (2%)” (p. 5).

The final category of *Regional and Socioeconomic Index of Areas (SEIFA) demographics of users* compared the HYHB app use across the region and with birth statistics. The data showed similar use across regions except for a 10% lower use in WA [Western Australia] compared to Perth. App users were found “across all quintiles of social disadvantage but were over represented in areas of lower disadvantage compared to distribution of WA births” (Hearn et al., 2014, p. 6).

This study reflects data supporting pregnant women and new mothers searching for lifestyle advice on the internet during child bearing years. Women requested on line access to concise, quick reliable answers regarding pregnancy and postpartum, self-assessment tools, and suggestions for change; preferring the information access through a

mobile device. Further, significant promise for supporting healthy behavior changes has been associated with use of online resources, especially mobile phone devices.

A study to understand the motivators and barriers to healthy eating in African American mothers was conducted by Reyes, Klotz, and Herring (2013). “Poor quality diet is common among low-income, overweight, African American mothers, placing them at risk for adverse pregnancy outcomes” (p. 1175). The purpose of the study was to comprehend the perceptions of these mothers which specifically facilitate or hinder healthy eating. The authors utilized a qualitative approach, conducting semi-structured individual interviews with pregnant African American participants. Participants who were African American, at least 18 years old, any gestational age, and received Medicaid were recruited from the waiting room of the outpatient prenatal care clinic. The authors oversampled the early pregnancy participants in their first and second trimesters. Sample size began with 29 scheduled interviews, 24 completed interviews and 3 excluded for BMI, therefore ending with 21 participants. Interviews were conducted privately with questions developed by the authors and pilot tested for clarity with a convenience sample of African American mothers. The interview data was coded for emerging recurrent themes. The reviewers met regularly to assess level of concordance.

Two major categories were utilized in arranging the themes; *motivators of healthy eating* (n=2) and *barriers to healthy eating* (n=8). Under the category of *motivators*, the first theme was *Healthy mom means a healthy baby*. Representative comments were “I feel better when I eat good, and I want to eat good because I want her [my baby] to get

nutrition, too” and “I usually go and get a sandwich...lunchmeat...I get wheat bread, cheese, mustard, lettuce, tomatoes...If it’s not good for my baby, it’s not good for me” (Reyes et al., 2013, p. 1177). Theme two was *Physical symptoms*, such as heartburn and nausea, inhibit unhealthy food intake. The physical symptoms the participants felt, such as heartburn, after eating fatty, fried, or fast food led them to decrease or stop eating unhealthy food. Participant comments were “I like baking (instead of frying). I don’t want heartburn. I don’t want my stomach to feel like sharp pains to where I’m really, really hurt in the middle of the night. I don’t wanna be so gassy” and “[I used to eat] a lot of processed foods, fried foods, but now, I can’t even take fried foods. I’ll have heartburn for hours, and it’s just horrible” (p. 1177).

The second category, *barriers to healthy eating* contained eight themes (#3-10). Theme three was *Taste and cost are strong drivers of food intake*. Many felt like the taste and cost which influenced choices before pregnancy continued during pregnancy. The participants felt healthy food cost more and wouldn’t buy healthy if they felt the family would not like the taste and then not eat or waste the food. A sample of comments were “I tried [diet drinks], but they had a weird taste. A lot of diet drinks are disgusting to me. I don’t drink diet drinks” and “I might call my mom, ‘I want this. I got a taste for this.’ And that’s mostly ...potato chips and cream cheese. I gots to have that in the house. I cannot run out of that at all” (Reyes et al., 2013, p. 1178).

The fourth theme was *Limited access to healthy food, but easy access to unhealthy food*. The participants did not have reliable transportation to the grocery store

or a close grocery store, therefore the corner convenience store became the choice for purchases which were unhealthy choices. Comments of “We go mostly every day. When you go to the (corner) store, you just see so much stuff that you want, and then you just get it” and “I don’t drive. So, when I get to the store, I have to go shopping for the entire month, because getting on the bus to go get groceries, it’s too much” (Reyes et al., 2013, p. 1179) are examples of these barriers.

The fifth theme, *Food supply fluctuates each month* reflects the participants who live in large, multi-generational households where the resources are shared or controlled by her mother, grandmother or even older sisters. There is a loss of control with food choices related to purchasing and preparing. As the end of the month approaches it is not uncommon for healthier foods to run out and not be available until the next month. For example, one participant stated “My brother, he’s like, ‘If you don’t want me to eat your stuff, just tell me.’ And I said, ‘these [cereal] bars are mine.’ And then he’ll just eat all my stuff like, ‘Oh, I forgot, I didn’t know.’ So I try to hide them...but then they call me stingy” (Reyes et al., 2013, p. 1178).

Lack of meal schedule persists in pregnancy, theme six, describes the behavior of not eating regular meals before pregnancy continuing and increasing during pregnancy when facing intense cravings or trying to control nausea or fatigue. Comments like “I don’t decide; I just eat whatever I crave for” and “Lunch is probably a juice or soda and chips or candy” (p. 1180) reflect the quick choices that persist in the theme. The seventh theme, reflecting barriers, was *Pregnancy related fatigue and sleepiness inhibit cooking*.

One participant stated “When I get tired, I eat more of the fast food. ‘Cause it’s more of, ‘I’m not cooking tonight, we’re going to find something to eat outside.’ ... a Chinese store, a pizza store. Or something quick, like a TV dinner.” (Reyes et al., 2013, p. 1178).

The eighth theme was *Misunderstanding about what defines “healthy”*. Some participants felt fruit-flavored drinks or ginger ale were good for them and the baby, commenting “I think Clear Fruit [Shasta Beverages, Inc.] drink is healthy because it’s got the kiwi strawberry and that stuff” while others labeled high-calorie meals as snacks, such as “(A snack is) like a burger, some fries. I just don’t consider it lunch yet. It don’t really fill me up.” (Reyes et al., 2013, p. 1180).

Theme nine, *Mothers don’t want to deprive their babies*, was reflected by most mothers who shared the belief that eating too little could harm the baby while few realized the danger of eating too much. Comments reflecting this thought were, “Sometimes I wanna eat one plate. Sometimes I wanna eat more than one... I can’t control it, it comes from the baby” and “I’m not gonna starve my baby ‘cause that’s just selfish.” (Reyes et al., 2013, p. 1179). The final theme was Family and friends pressure mothers to eat. The participant family’s encouragement to eat often influenced eating negatively. Examples of this were “”My family says eat as much as I want. And just keep eating, ‘cause it’s good for the baby.” and “She [mom] gave me the portion. I was like, ‘Whoa, this is a lot.’ She was like, ‘Oh, you’re eating for two! It’s not that much.” (p. 1179).

The study identified that despite good intentions to improve diet during pregnancy many barriers exist. The barriers included cost and taste of food, not understanding which foods are healthy, not having food available, and family advice and pressure to eat. Lifestyle interventions should consider these barriers when sending intervention messages and include suggestions on how to deal with the barriers. An example would be to encourage planning meals and snacks by texting reminders about what foods and when to eat at scheduled mealtimes. Intervention messages could also focus on the motivators and empower moms to make good choices for themselves and the baby. With more barriers than motivators identified in the study, it is evident there is a need for education addressing these barriers and healthy eating.

Lucas, Charlton, and Yeatman (2014) conducted a systematic review of the literature to identify pregnant women's sources of nutrition information, their perceived needs for nutrition education, the healthcare provider's perceptions about nutrition education, and to assess public health programs effectiveness in changing nutritional practice. A Scopus data base search of peer reviewed qualitative and quantitative articles published in English from developed countries (Australia, New Zealand, United States, Canada, United Kingdom, and European Countries) between 2002 through 2014 were included. Of 506 identified in the search, 25 were eligible for the study. Additional searches with the same criteria were conducted with Medline and Proquest. A total of 31 articles were included in the study. Results indicated a lack of nutrition education during pregnancy. "Although healthcare practitioners perceived nutrition education to be

important, barriers to providing education to clients included lack of time, lack of resources and lack of relevant training” (p. 2465).

Three categories were utilized to organize the articles: *pregnant women, healthcare professionals and public health interventions*. Under the first category, *pregnant women: type, sources, and perceptions*; the articles showed a lack of nutrition education for pregnant women, with education not occurring until 12 weeks gestation in some instances, which was felt to be too late. The education received covered topics from dangers (mercury, listeria) to supplements (iron, folic acid). The articles showed women commonly seeking information from outside sources such as pregnancy books, magazines, and the internet although reliability was a concern. They frequently searched for food related answers even though concerned with reliability. Women did not consider the information given by family and friends. Women tended to not change behavior (take supplements) when they felt they were too busy to make changes or other sociocultural factors were more important (reducing dietary sugar). The articles reflected that women preferred to receive nutritional information in a written format or pamphlet and adolescents specifically liked listening to teachers or healthcare professionals (Lucas et al., 2014).

Under the second category, *healthcare professionals: perceptions of providing nutrition education to pregnant women*, most studies found practitioners felt education covering nutrition and physical activity were important. Practitioners providing advice were much lower than those expressing the importance. Over half of the practitioners felt

a need for further nutrition education training but did not pursue due to lack of time, cost, or relevant training availability (Lucas et al., 2014).

Under the third category, *interventions: identifying effective methods to deliver nutrition education to pregnant women*, the articles identified increased counseling as a method to improve nutrition knowledge, stimulate seeking further education and adherence with suggested supplements. In addition to counseling, providing appropriate food examples was suggested to improve choices. Identified methods of implementing the interventions were through videos on nutrition, and use of an interactive video including nutrition advice and exercise was beneficial. Various pamphlets and ‘pocket books’ were also found to be useful (Lucas et al., 2014).

According to the authors (Lucas et al., 2014), “The limited available data in the published literature indicates that pregnant women in developed countries are not receiving adequate nutrition advice from reputable resources, namely healthcare professionals” (p. 2472). Most of the studies “were low quality and cross sectional in nature” (p. 2472), and only one of the randomized control studies was found to have a low risk bias. Healthcare practitioners needed further nutrition education themselves as well as need to provide earlier and increased education to pregnant women. Women responded to advice when it was specific and included explanations. Further investigation of effective nutrition education during pregnancy is needed to facilitate timely delivery of nutrition advice.

Physical activity, in conjunction with appropriate nutrition education and intake, is known to influence weight gain. In 2012, Krans and Chang stated “exercise may decrease the incidence of obesity and obesity related complications during pregnancy... African American women are at higher risk for obesity and physical inactivity during pregnancy when compared to other patient groups” (p. 1180). The authors conducted a qualitative study to provide a detailed description of the unique beliefs and perspectives African American women have regarding exercise during pregnancy. Purposeful sampling was used to intentionally select “information-rich cases” (p. 1181) for better understanding. The sample was recruited from three urban community health clinics in a low socioeconomic status neighborhood. The sample consisted of 34 pregnant African American women, at any gestational age, at least 18 years of age, and had a low risk pregnancy at time of the focus group. Most of the women “were single (94%), had only a high school education (67%), received Medicaid (100%) and had a mean BMI of 33 kg/m²” (p. 1180). The authors conducted six focus groups, consisting of 2-8 participants, who gave verbal consent. The authors utilized open-ended, semi-structured questions to guide the 60-90 minute discussions. A pilot study was conducted on the questions with pregnant African American women and reviewed by healthcare providers in obstetrics. The transcripts of the focus groups were qualitatively analyzed and coded for major themes.

Three major themes were identified: *Defining exercise, benefits of exercise during pregnancy, and concerns about exercise during pregnancy* (Krans & Chang, 2012). The

first theme, *defining exercise: exercise as an activity of daily living* emerged from comments considering their routine activities as exercise, such as walking as a form of transportation, the physical demands of a job, caring for children, or cleaning house. Examples were “I said the hills when you don’t have a car...Going up a hill...Without a car, that’s exercise” and “I don’t exercise in the gym, but I do at work. I’m forced to [exercise] actually [as a nurse’s aid]” (p. 1183).

The second theme, *benefits of exercise in pregnancy: exercise prevents weight gain and eases labor* emerged from statements that all participants believed exercise benefits and most believed it would help with labor. Comments supporting this theme were “Well, my mom, she says it’s very important because if you don’t move around, you’ll get sore and achy. And she said that you just have a better pregnancy when you do exercise” (Krans & Chang, 2012, p. 1183).

The third theme, *concerns about exercise during pregnancy*, emerged from the belief the baby could be harmed if they exercised too much. Additionally, a lack of knowledge concerning safe exercise during pregnancy and a belief that certain movements were actually harmful as described by their family. Illustrative participants comments were “If you’re overactive, then like you go on bed rest [and if] the baby comes early and then you’ll have problems” and “[I’m] scared that I’m doing the wrong thing and something is going to go wrong” (Krans & Chang, 2012, p. 1184). Further, regarding movements, they stated “I’ve heard don’t raise your arms up too much because you can get the cord wrapped around the neck. Because I do my own hair and...my

boyfriend's sister is like no you can't. Like after so many months you can't do it because the cord will get wrapped around...I don't know if that's true or not, but that's what she said" (p. 1184).

The findings described several beliefs of African American women. They often view daily activities as exercise, such as walking, duties on the job, child care, or house cleaning and did not view structured exercise as a viable option. Women believed exercise is beneficial during pregnancy and helps labor, which was supported by their family. A knowledge deficit regarding what constitutes safe exercise, concerns about too much exercise being harmful or cultural myths that certain movements cause problems with the baby were identified. The findings from this study are not generalizable due to small sample size and convenience sampling but these findings can be used to facilitate the development of education and exercise interventions specifically for African American women. The authors identify the importance of identifying types of daily activity women have when developing an exercise plan. A specific list of accepted exercises, including duration time and frequency would increase knowledge and encourage women to participate in regular exercise, such as walking, aerobics, or yoga for 30 minutes a day on most days of the week. The findings encourage considering cultural myths in all education and exercise recommendations.

Evidence in the literature supports the benefit of appropriate nutrition and physical activity during pregnancy on maternal and fetal outcomes. It further supports the need for nutrition and physical activity education during pregnancy to facilitate increased

adherence and participation. Healthcare practitioners have not been providing this education at the expected level (Lucas et al., 2014).

Mobile Phones

The International Telecommunication Union (ITU) (2013) estimates there are about 6.8 billion mobile subscriptions worldwide, equivalent to 96% of the world population. It is estimated that in the developed world, the saturation point is rapidly approaching with at least one mobile subscription per person.

According to the Pew Research Center's *Internet and American Life Project* (2011) "83% of American adults own cell phones and three-quarters of them (73%) send and receive text messages" (p. 2). The Pew national phone survey included 2,277 adults, 18 or older from April 26 – May 22, 2011. Approximately one-third stated they preferred a text instead of talking while 14% stated it depended on the situation. Young adults age 18-24 are the highest volume users of texts with an average of 109.5 messages a day, and median receipt of 50 messages a day. The study found higher text message use with non-whites, especially African Americans, and with lower income and education levels. These numbers, basically the same as 2010, indicate that use has stabilized.

In 2012, the Pew Research Center's *Internet and American Life Project* reported the teen texting volume is higher than before, with 75% of all American teens sending and receiving texts. The reported median volume of texts for a teen aged 12-17 is 60 a day, up from 50 in 2009. Specifically teens aged 14-17 were responsible for higher volume with a median increase from 60 in 2009 to 100 a day in 2011. Consistent with

adult texting, African American teens displayed a median rise from 60 to 80 texts a day. Mobile telephones, the fastest growing technology worldwide, are now being utilized by the health care consumer for their own health interests.

Mobile Health

The use of mobile telephones by the health care consumer or patient is changing how health care is delivered. The process of using mobile technology is called mobile health or m-health. M-health has been used by practitioners and researchers in a variety of ways such as the collection of community and clinical data and documentation of community health care. Initially, mobile devices including laptop computers, tablets, and personal digital assistants were used; although mobile telephones have now become increasingly more popular with practitioners. With the increased number of adults and adolescents using cellular phones, it is a logical step for providers to begin interacting in the public and patient arena through m-health, focusing more on the consumer use and not just the provider.

The increase in technology use in healthcare is partially driven by the Health Information Technology for Economic and Clinical Health Act (HITECH), part of the 2009 American Recovery and Reinvestment Act (McBride, Delaney & Tietze, 2012). The goal of the act was “to promote and accelerate the implementation and adoption of EHRs in hospitals and ambulatory care clinics by 2015” (p. 38). Out of this came the directive to show meaningful use described by the federal government as “using the technology in a meaningful manner (for example, the use of electronic prescriptions),

using it to exchange health care information electronically, with the goal of improved quality of care, and using it to gather clinical quality measures” (p. 39). A financial incentive program from the Centers for Medicare and Medicaid Services (CMS) (2012) was designed to encourage electronic health record (EHR) implementation and offset costs through 2016. Core measures were developed to assist with implementation. Specifically in Stage 2, Measure Number 13: “Use clinically relevant information from certified EHR technology to identify patient-specific education resources and provide those resources to the patient” (p. 8) and Measure Number 17: “Use secure electronic messaging to communicate with patients on relevant health information” (p. 8) to incorporate the use of text messaging with patients.

For several years, studies have been conducted with calling patients to follow up on care or for support. In the last 6-10 years, there have been more studies implemented utilizing texting to support a patient while on a diet or exercise regimen, in the management of their disease processes such as asthma, and in an effort to increase attendance at immunization and general clinic appointments. Most of these studies have been in the adult population. Some have been geared toward adolescents, children and their parents (Ahlers-Schmidt et al., 2011; Ahlers-Schmidt et al., 2012; Coker et al., 2010; da Costa et al., 2010; Downer et al., 2006; Gerber et al., 2009; Perron et al., 2010; Petrie et al., 2011; Stockwell et al., 2012).

Woolford, Clark, Strecher, and Resnicow (2010) focused on text messages with adolescents as an additional method in treating obesity. Other approaches were

addressed in the study by Hingle, Nichter, Medeiros, and Grace, (2013) with the development of healthy lifestyle messages. These are discussed below.

Immunization and appointment reminders. Stockwell et al. (2012) conducted two separate studies of the impact of text message reminders in an urban, low income population on pediatric and adolescent immunizations. *Text4Health* adolescents and *Text4Health* pediatrics were reported at the same time. In *Text4Health* adolescents, the authors conducted a randomized trial to assess the effect of text messaging on receiving specific immunization(s). The sample included parents or guardians with a child age 11-18 years that needed specific immunizations, had visited a study site in the past year, and had a cell phone. Patients were randomly selected from intervention sites and matched by gender and age plus or minus 1 year, to randomly selected patients from control sites. Text messages of vaccination needs were sent to intervention parents at weeks 1, 2, 3, 6, and 7, or were stopped if the immunization was administered. Messages contained the child's name, clinic name, and times immunizations could be administered at the clinic. Parents in the control group received standard care without immunization reminders.

Demographic data were collected from the clinic system. Differences between groups on additional vaccine and any vaccine were analyzed with the chi-square test at 4, 12, and 24 weeks. An analysis of variance was conducted to assess the influence of between-site variability on outcomes. To assess impact of demographic variables, multivariable logistic regression was utilized. "With a sample size of 150, a power of 80%, and an α of 5%, the study was (conservatively) powered to detect a 15-percentage-

point difference between intervention and control participants” (Stockwell et al., 2012, p. e16).

In *Text4Health* pediatrics, the focus was to contact parents of children with overdue immunizations caused by a previous shortage of vaccine. The sample consisted of 174 parents who had a child between 7 and 22 months, who was missing the immunization, had been seen at the clinic in the past year, and had a cellular telephone. Parents were randomized into control (paper mailing alone) or intervention (mailing plus 3 text messages) groups. Both methods stated what immunization was missing due to the shortage plus date, time, and location of sessions.

Again, demographic data were obtained from the clinic system. The chi-square test was utilized to test for differences in attendance between the groups, using intention to treat. “With 80% power and an α of 5%, the study required a sample size of 90 in each group to detect a difference of 15 percentage points, assuming a baseline attendance rate of 5%” (Stockwell et al., 2012, p. e16). To assess influence of demographic variables, multivariable logistic regression analysis was utilized. A comparison of those who received the immunization was completed with the chi-square test.

Text4Health adolescents had a total of 195 parents in the intervention group and 166 in the control group. There were no significant differences between groups or immunization rates at the baseline. Findings indicated the intervention group received the immunizations in greater numbers than control at four weeks (4.2%, 11.2 percentage-point difference; 95% CI = 5.3, 17.1; $p = .001$); at 12 weeks (26.7% vs. 13.9%, 12.8

percentage-point difference; 95% CI = 4.7, 20.9; $p = .003$); and at 24 weeks (36.4% vs. 18.1%, 18.3 percentage-point difference; 95% CI = 9.4, 27.3; $p = .001$) (Stockwell et al., 2012). Significant differences were noted with the nested ANOVA at all three time points between the intervention groups. Multivariate analysis showed intervention status alone was significantly related to immunization receipt at 4, 12, and 24 weeks.

Text4Health pediatrics had 87 parents in the intervention group who received texts and letters and 87 parents in the control group who received letters only. No differences between groups were noted at baseline. A significant difference was seen in attendance by intervention group children whose parents received texts and letters (21.8%) versus letter only control group (9.2%) ($p = .021$). Multivariate analysis showed sessions attended was affected by the intervention group only “(adjusted odds ratio [AOR] = 2.78; 95% CI = 1.10, 6.98)” (Stockwell et al., 2012, p. e 18).

The authors noted that adolescents were significantly more likely to get immunizations if their parents received text message reminders. Further, the pediatric participants were more likely to attend an immunization session if their parents received text reminders than those who received a letter only. Both studies suggest text message reminders can be effective for increasing pediatric and adolescent immunizations.

Downer et al. (2006) studied text message reminders to patients with clinic appointments, specifically failure-to-attend (FTA) and financial benefits. The intervention group included all patients (22,658) with an appointment (new or return) scheduled during the same three month period the year before. Both groups’ participants

had a cell phone number registered in the database. A text message reminder was sent to the intervention group three days before their scheduled appointment. The text contained the clinic name and number and the appointment day, date, and time. Attendance was obtained from the clinic system at the conclusion of the study.

Two-sample proportion tests were conducted to assess variations in FTA rate. To demonstrate any connections between text reminder and attendance a risk ratio analysis was conducted. The cost of sending texts was then compared to the financial benefit (revenue from attended appointments). Results indicated significantly lower FTA rates with the intervention group (9.8%) versus the control group (19.5%) utilizing a two-sample test of proportion ($z = 29.32, p < 0.001$). The risk ratio analysis demonstrated the control group, who had not received text reminders, were more likely to not attend appointments (risk ratio = 1.596). There were no significant differences between groups at baseline. The authors further analyzed the new and return appointments separately with a two-sample test of proportion. Return appointment findings indicated lower FTA rates in the intervention group (9.9%) versus control group (20.9%) ($z = 28.59, p < 0.001$); with comparable results in the new appointment findings, intervention group (9.2%) versus control (14.7%) ($z = 8.50, p < 0.001$) (Downer et al., 2006). Over the three month time period, the cost of sending text messages was \$5,164, with “a hypothetical 11.5% (\$273,993) revenue increase in revenue for the control group” (p. 392). For the new appointments, a \$9.64 (6.4%) increase of modelled average revenue was earned while the

return appointment increase was \$12.96 (13.9%) attributable to the increased attendance observed.

Text message reminders significantly reduced the FTA rates in the intervention groups, or increased appointment attendance for both new and return appointments. Text reminders are a reasonably inexpensive method to increase appointment attendance and revenue.

da Costa, Salomão, Martha, Pisa, and Sigulem (2010) studied the impact of text message reminders on appointment nonattendance rates. A convenience sample was drawn from four clinics with an existing appointment system. Of the 29,000 scheduled appointments over one year, 7,890 received text message reminders. The rate of attendance and non-attendance were reviewed in relation to those who received text messages reminders and no reminders. To assess the statistical significance between these rates, Fisher's exact test was conducted, at a 95% confidence interval.

Results indicated a significant reduction of non-attendance rates with text appointment reminders at three of the four clinics. A mean non-attendance rate of 25.57% was seen with no appointment reminder and 19.42% with text appointment reminder. The increased attendance rate generated enough revenue to cover the cost of the text messages and a surplus to clinics, in addition to the texting module development. This large study supports the possibility of text message reminders to decrease the non-attendance rate of appointments.

After studying if text messages were helpful, it was necessary to study what content in the text message was the most helpful. Ahlers-Schmidt et al. (2011) studied preferred content for text message reminders sent to low-income parents. The sample included 190 English speaking parents with children under six who attended a Midwestern Pediatric Residency Clinic. Participants were given three examples of text messages and asked to select which one included the information they would want to receive.

“The majority of both Hispanic (67%) and non-Hispanic (86%) respondents were interested in receiving text messages” (Ahlers-Schmidt et al., 2011, p. 120). No significant differences were found between group interests in receiving text messages. The second option was selected by 50% of the respondents with a split of those remaining selecting one and three. A chi-square analysis was conducted to determine if the message preference differed by ethnicity. A significant difference was found between Hispanic and non-Hispanic respondents ($\chi^2 (2) = 6.36, p = 0.042$).

Identifying the best message content would increase the success of text message reminders. The preferred option contained basic information, such as patient name, immunization due and date, the physicians name and contact number, while not including information describing why it is needed. The option was short, simple, and personalized.

Ahlers-Schmidt et al. (2012) further studied the design of text message immunization reminders using human factors techniques. The convenience sample consisted of 50 parents, age 18 or older, who had a child age two or younger. The parents

were English speaking and were able to use a mobile telephone and send and receive texts. Each participant was assigned to one of three user centered design groups; card sort, needs analysis, and comprehension testing.

The card sort group ranked text message cards into three groups; critical information, additional/clarifying information, and unnecessary information. The needs analysis group rank ordered the eight text messages that had critical information arranged in a variety of ways. The comprehension testing group read the messages and explained the content and completed the CDC Behavioral Risk Factor Surveillance System Questionnaire.

Categorical data were reported in frequencies. Continuous data were reported by means and standard deviations. Cohen's kappa was utilized for the analysis of interrater reliability and to compare self-report and observed skills. "Kendall's W for comparison of ranks was computed for the needs assessment. For the card sort, data analysis using Microsoft's UXSort software resulted in a dendrogram and category frequencies" (Ahlers-Schmidt et al., 2012, p. 539).

Ninety-eight percent of participants expressed interest in receiving immunization reminder text messages. The respondents reported sending an average of 439 text messages a week (SD = 1010.97, range 14-7,000). Interrater reliability of texting skill for self-report ($k = 0.91$) and observed ($k = 0.71$) was acceptable. "Cohen's Kappa indicated a significant relationship between self-report and observed skill ($k = 0.709$, $p < .001$), with 82% of respondents exhibiting the highest text messaging skill level" (Ahlers-

Schmidt et al., 2012, p. 539). The identified critical information in the text messages was child's name and age, doctor's name and number, general reminder and immunization due date. Two of the top three ranked messages contained critical information only and the last had two additional pieces of information. All participants felt the word 'reminder' at the beginning of the message ensured the message was read. All participants explained the messages in their own words demonstrating understanding, and would respond promptly.

Parents were able to select the most important information for immunization text reminders, plus felt inclusion of the word reminder at the beginning of the message was beneficial. This served as an alerting purpose, which may increase attention and response time.

Health management. A study to improve use of asthma medication was conducted by Petrie, Perry, Broadbent, and Weinman (2011). The authors studied whether receiving text messages focused on changing patients' illness and medication beliefs would improve medication use by adult asthma patients. The sample participants were English speaking, 16-45 years old, had a diagnosis of asthma, were not currently taking prevention medications, and had a cell phone with text capabilities. Ninety-three (75%) of the 147 enrolled, completed the study. After a baseline assessment using the Brief Illness Perception Questionnaire, the participants were randomly assigned to the text message group or control usual care group. Phone calls at 6, 12, and 18 weeks plus 6 and 9 months were conducted to assess adherence to medications. The baseline

questionnaire was also repeated at 18 weeks. The treatment group received text messages for 18 weeks, specific to their beliefs, at the rate of two per day weeks 1-6, one per day weeks 7-12, and three per week for the remaining weeks 13-18.

From previous research, the authors estimated mean baseline adherence rate at 50% (SD = 25%), with a 15% increase seen as clinically relevant. This resulted in an effect size of 0.6. At the 5% level of significance, with 80% power, the researchers needed 50 participants in the intervention and control groups. To assess differences between groups in illness perception changes, an ANCOVA analysis was performed. A mixed ANOVA was utilized to evaluate the adherence over time and between groups. Finally, the overall mean adherence between groups was compared by averaging each participant's adherence rate across all points then conducting an independent samples *t*-test. Additionally, those participants with an average adherence rate of 80 or greater were compared with the Pearson's chi square. Tests were two-tailed and $p < 0.05$ was set for statistical significance.

The drop-out rates, according to chi-square tests, showed no significant difference between groups. After comparisons at baseline and six weeks, results showed the participants who dropped out to be significantly more adherent than the remaining participants "mean 67.1% vs. mean 46.7%, $t = 4.47$, $p < .001$ " (Petrie et al., 2011, p. 6).

At 18 weeks, the intervention group showed a change in illness and medication beliefs toward greater adherence. There was no difference between the groups at baseline. "Average self-reported adherence over all time points in the control group was

43.2% (SD = 26) and the intervention group was 57.8% (SD = 27.1, $t(122) = -3.06$, $p = .003$)” (Petrie et al., 2011, p. 6). The authors found the participant specific text messages to the intervention group changed timeline (mean 9.09 (SD = 1.81), $p = .006$), personal control (mean 8.02 (SD = 1.56), $p = .009$), and medication necessity (mean 6.52 (SD = 2.98), $p = .01$) beliefs at the 18 week time point. The targeted text messages resulted in changes in illness and treatment beliefs and adherence to medication protocols.

Gerber et al. (2009) studied the feasibility of using text messaging for continuous communication with African American women in a weight management program to maintain weight, prevent relapse, and maintain motivation. The participants in an ongoing study suggested use of text messages for reminders. The sample participants were all women participating in the Obesity Reduction Black Intervention Trial (ORBIT). The women were African Americans in the Chicago area, ages 30-65 years with body mass indexes (BMI) between 30 and 50. Mobile telephones were provided if participants did not have one. The participants selected three weight control behaviors for support through texting, composed personal text messages and identified times and days they were to be delivered. The authors created additional messages on healthy eating and physical activity. Two general text messages and one or more personal messages were sent each week to those who created messages. Other participants were sent three general health messages a week.

Seventy-three women completed questionnaires at the end of the study. Of the 94% that reported reading the text messages, 54 of 68 (79%) felt the messages helped

toward goals. The authors reported that, “most of the subjects welcomed the text messages” (Gerber et al., 2009, p. 20). Others wanted the messages throughout the entire program or more messages. Participants were basically very positive and many felt that text messages affected their behavior. Participants accepted text messages as communication and requested they begin earlier in the program as well as an increased number of messages.

Texting with Adolescents

Greater than 75% of adolescents in the United States own a cell phone and say they text regularly (Pew, 2012). Research is beginning to study the feasibility of utilizing this venue to support and influence adolescent healthcare. Studies are focused on exploring how adolescents feel about using texts for health and what they want or on actually how text messages influence adolescent health.

Woolford, Blake, and Clark (2013) explored ways of communicating with adolescents in health care. They found that adolescents have email although it is not a preferred method of communicating. Mobile phones and texting is heavily used by adolescents to interact with friends. Social media is accessed by approximately half of the adolescents surveyed although this is not preferred or always positive communication. Lastly, although adolescents are very familiar with video chatting, such as Skype or FaceTime, this is not their primary method of communication.

Texting has been used in health care for appointment or treatment reminders, to deliver laboratory information, and support behavior change efforts. Currently, most

communication is initiated by the provider for greater control of the interaction and may only request specific feedback from the patient. According to the authors, providers are interested in text message use in healthcare although they identified several concerns: cost to the practice, parent preference, privacy and liability (Woolford et al., 2013). The authors found more support for reminders for appointments or medications, than for sensitive health updates or test results. Parental interest in texting adolescents, although accepted, was influenced by several factors; age and reason for communication (reminder versus monitoring health condition) and if they had access to the message sent from the adolescent. Adolescent perceptions of text messaging has been varied. Adolescents commented it felt weird or strange receiving text messages from a provider rather than a friend. Positive comments from adolescents referred to text messages regarding sexually transmitted infection (STI) prevention. However, the texts related to STI messages being viewed by other than the participant was a major point of concern. Overall, adolescent participants welcomed text messages regarding behavior change suggestions or support (Woolford et al., 2013).

The authors suggest planning related to who will send and receive the messages, legal implications, security, type of information sent and received, and what consent is needed. A communication continuum is presented with safer business practice examples on the far left and riskier clinical care on the far right. The examples from safer business practices, on the left side of the continuum, to riskier clinical care, on the right side of the continuum, are appointment reminders, immunization reminders, behavior change

interventions, test results, bidirectional, and social media interventions. Most adolescents, parents, and providers are willing and excited to utilize text messaging for health care communication.

Coker et al. (2010) explored perspectives held by “adolescents and their parents on ways to encourage adolescent utilization of preventive health services” (p. 133). A random sample of adolescents enrolled in a commercial health plan for the last 12 months were contacted by recruiters. The sample consisted of 77 adolescents aged 13-17 years, had parental consent, lived within 15 miles of focus group site, and spoke English or Spanish. The adolescent sample was divided into eight focus groups of 6-12 participants, grouped by gender, age (13-15, 16-17), and primary language spoken (2010). Three main topics of discussion were developed: “(1) views on and experiences with preventive visits; (2) ways in which health plans, clinics, and clinicians can help to increase adolescent access to and utilization of preventive visits; and (3) strategies that health plans, clinics, and clinicians can use to encourage teens to discuss important health-related topics during preventive visits” (p. 134). Each focus group session lasted approximately two hours.

Codes were created for the key points from the first two transcript texts, which were developed into a codebook through an iterative process. All transcripts were then coded individually, discrepancies discussed and modified. A Cohen’s Kappa was calculated to measure the coders’ consistency. Excellent consistency was suggested with

scores of 82%-92%. Using grounded theory, thematic analysis of 1,067 quotes related to the three major topics was performed.

The emerging themes for Topic 1, views on and experiences with preventive visits, were:

- “Importance of preventive visits: A focus on physical health as the key element of preventive care” (Coker et al., 2010, p. 135). Parents and teen participants had similar perceptions. Both focused on physical health and assessment as the value of preventive care.
- “Experiences with preventive visits: Brief doctor-patient time leads to few opportunities for effective doctor-patient communication during visits” (p. 135). Again parents and teen participants had similar perceptions regarding the experience of brief time with the doctor during physical assessment and little encouragement of questions or time allowed for communication with the doctor.
- “Barriers to preventive visits: Adolescents described reasons why teens do not attend preventive visits” (p. 136). Both parents and teen participants identified similar barriers with excessive waiting room times and clinician-patient relationships. Additionally, teen participants commented on poor transportation options to appointments, a lack of time spent with clinician, and a perceived lack of confidentiality and privacy (2010).

Identified themes related to Topic 2, ways to increase adolescent access to and utilization of preventive visits, were:

- “The best way to encourage preventive visits is to provide patients with a good, continuous relationship with a clinician who respects their time and confidentiality” (Coker et al., 2010, p. 136). Teen participants commented that positive visits and interactions with clinicians make it easy to return, while parents felt the clinician being kind would be important.
- “Structural changes that improve adolescents' experience accessing and receiving care can increase the likelihood that teens will return for annual visits” (p. 136). Parents and teen participants both identified changing the waiting room time as increasing annual visit returns. Further, teen participants commented that spending more time with doctor, getting the same doctor at each visit, and being assured of confidentiality were areas where changes could increase annual visits.
- “Incentives, though not necessary, may be a successful way to get teens to utilize preventive visits” (p. 136). Parents and teen participants were similar only in comments of receiving small incentives. Teen participant suggestions ranged from small incentives of cash, event tickets, and condoms, to large incentives of raffle tickets for concerts, iPods, or cell phones. Parents had additional comments such as continuity of care, effective communication, and the use of reminders like a telephone call or postcard as ways to increase utilization of visits.

Themes generated by Topic 3, strategies to encourage teens to discuss important health-related topics during preventive visits, are as follows:

- “Providing teens with confidential face-to-face discussions with a provider they have a continuous relationship with is the best way to encourage teens to discuss sensitive topics with their providers” (Coker et al., 2010, p. 136). Teen participants stated continuity with the same clinician, a relationship with the clinician, and ensuring confidentiality and privacy would encourage more discussions.
- “Technology-driven tools (including text messages and MySpace) can also be used to encourage discussion of sensitive topics, and to augment risky health behavior screening and counseling outside of the face-to-face office visit” (p. 140). Teen participants felt technology would facilitate counseling, present fewer hassles, and provide greater anonymity in addition to supplying a way to receive information without having to be face to face with the clinician. Parents focused mostly on the clinician relationship. Many parents also supported the use of technology, while others were hesitant to use this tool.

Parents and teens both commented that clinicians need to address the barriers identified to encourage greater utilization of preventive care. The clinician-patient relationship was also identified as important, in addition to implementing technology driven tools as effective ways to improve care.

Woolford et al. (2010) used technology tools, specifically, tailored text messages with adolescents for supplemental obesity treatment. The authors completed this feasibility study in three stages: creating messages, tailoring and computerizing, and implementation.

First, 90 evidenced-based messages were created which focused on eating breakfast, increasing fruits and vegetables, and decreasing sweet drinks, fast food, and screen time (Woolford et al., 2010). Messages were stated in a positive tone and motivational nature to stimulate thought. An image bank of 60 images was then created around six categories: family life, peers, fashion, food and beverages, sports, and outdoor settings. Participants selected two from each category to be sent throughout the interventions.

Second, using each participant's selected target behaviors from a baseline data questionnaire, the messages were customized to the participant. The messages were loaded into a computer program to be delivered to participants daily at 4:00 in the afternoon for 90 days. Reminders of exercise classes were sent three times a week in addition to the tailored messages.

The third phase, implementation, was conducted with a convenience sample of 20 adolescents recruited from a weight loss program. The mean sample BMI was 38 kilograms per meters squared, greater than the 95th percentile. Telephones were provided if requested. Each month, a survey was completed and at the end a semi-structured interview examining perspectives was conducted.

Participants felt messages were appropriate and helpful, and timing worked well. A few felt a larger variety of messages would be helpful and the breakfast messages would be more helpful in the morning. Recipes and meal suggestions were most popular. They felt messages were pertinent to them specifically, and helped them make good choices. Most felt the messages were great reminders and kept them focused.

Participants welcomed additional support from the text messages, believing they were relevant specifically to them. Most felt once a day at 4:00 in the afternoon was an appropriate amount and time. Many stated the messages helped them stay focused on the program although adherence or BMI changes were not measured in the study.

Boyer, Levine, and Zensius (2011) explored “how youth and young adults, particularly youth of color, use technology to learn, communicate, and discuss sexual and reproductive health” (p. 6). The youth and young adults group was described as participants aged 13-24 years. Multiple data collection methods were utilized. First, qualitative interviews were conducted with professional stakeholders by phone and recorded to deduce the digital media and technological influence on the subject of sexual and reproductive health. Second, a survey was conducted online to gather information about “youth and young adults use of digital programs and devices, knowledge of sexual and reproductive health, and related services” (2011, p. 9). Third, focus groups were conducted in Oakland, California and Chicago, Illinois. Last, a non-systematic method was used to review published and syndicated reports focusing on the areas of sexual and reproductive health, digital, education, and consumers.

The results indicated the participants were concerned and interested in obtaining information (Boyer et al., 2011). The information had reached some youth, although gaps still existed in youth of color. The five main sources utilized to learn about sexual and reproductive health were identified as school, friends, family, health professionals, and online sites. Utilizing school and friends as sources were consistent with existing knowledge. Youth today are closer to parents and often get assistance from them or other parental figures. Health professionals are utilized for information more as the youth ages and they see the professional as a peer rather than an authoritative figure. A wide variety of technology options are utilized from laptops, digital music players, to cell phones. The authors further found the “digital divide has all but disappeared, with little difference in technology usage based on socio-economic status or race and ethnicity” (2011, p. 19).

Surveys were obtained from 1500 participants, ranging in age from 13-24 years of age, and consisting of Caucasian (46%), African American (27%), Hispanic (11%), Asian (4%), and Multicultural (9%) groups (Boyer et al., 2011). Results indicated 93% of respondents own a cellular telephone or smart phone, while 67% own a laptop. Focus groups included 113 participants aged 13-24 and consisting of Caucasian (4%), African American (68%), Hispanic (4%), Asian (5%), and Multicultural (13%) groups. Results indicated many urban youth had regular access to internet services from home or mobile phone although few were on a smart phone. An increase in mobile telephone usage was seen with teen respondents texting (69%), talking (61%), and taking photos (56%) being the most popular use, followed by mobile social networks (37%), surfing the Internet

(37%), games (36%), and videos (31%). The eleven interviews with professional stakeholders indicated hope as new technologies, integrated with clinical services and in-person support, present possibilities for increased range, access, and connection with underserved youth. Further, simple technology services, such as texting used to reach the widest possible audience, are the focus of most agencies.

Respondents' utilized technologies to search for information although were reluctant to participate in public digital areas. Services that use the Internet and social networks that offer private support to reach youth may be received more readily. Additionally, reinforcing digital messaging with in-person communication has the best potential to reach youth in their own space and in a way to which they can relate.

Texting with Pregnant Women

Several specific texting studies during the prenatal period have shown mixed results with regard to health knowledge, diet management, and exercise (Cormick et al., 2012; Gazmararian et al., 2014; Jordan et al., 2011). Although no studies were found related to texting prenatal appointment reminders, pregnant women had increased satisfaction with prenatal care when receiving short text messages (Jareethum et al., 2008).

Text4Baby aims to demonstrate the potential for mobile technology to impact the health knowledge of women across the United States (U.S.). Jordan, Ray, Johnson, and Evans (2011) describe a national texting program for low income pregnant and parenting women in the United States. This service is available through the efforts of many

agencies, public-private partnerships, and non-profit organizations. The *Text4Baby* program provides health information throughout pregnancy and the first year following, correlating to gestational age or infants' age. Women are told about the program and encouraged to sign up at their initial prenatal visits, in the Emergency Room or obstetric triage, or during postpartum, if not already utilizing the program.

The messages were developed by the National Healthy Mothers Healthy Babies Coalition, the Centers for Disease Control and Prevention and federal partners. Messages were reviewed by a panel of experts and are evidence based. The participant receives three texts each week, which are free of charge. According to the authors, this “technology is reaching the intended audience” (Jordan et al., 2011, p. 211). By June, 2011 greater than 155,000 women had enrolled since February, 2010. The Spanish version accounts for 5% of the enrollees. Sixty-one percent of users are in households with a median income less than \$50,000, according to Zip Code analysis of 50 states. The results indicate the intended women are using the program, although further review is required to evaluate effectiveness, such as change in health behavior and maternal/fetal outcomes.

Gazmararian et al. (2014) studied “factors related to the enrollment process and reception of *Text4Baby*” (p. 223). Two Women's Infants' and Children (WIC) clinics were the sites for the prospective cohort study. The sample consisted of English speaking pregnant women 18 or older, who had a cellular telephone and could receive texts and had not been enrolled in *Text4Baby*. Postpartum women were also included in the study if

they had a child within the last 10 months plus the same criteria as pregnant women. Of the 468 women randomly selected out of all eligible patients at the clinics, 209 completed all surveys. Each participant received text messages three times a week. A baseline survey was conducted at a WIC visit, consent was obtained, and sign up directions were given to participants. A week later a follow up telephone call was made to the participants to identify any problems with sign up and to assist with sign up for the women still interested in participating. The final survey was conducted by phone two months after registration. Baseline and final surveys took 10-15 minutes and 15-20 minutes respectively to complete. Up to 15 attempts were made to contact participants, if necessary. Due to difficulty reaching participants it actually took from one to twenty-two weeks for the first follow up telephone contact of baseline survey (resulting in 1.6 weeks median time) and two to nine months for the final survey completion, with a 4.5 month median time (Gazmararian et al., 2014).

The authors calculated the descriptive statistics of frequencies, proportions and 95% CIs. The Rao-Scott Chi square test was utilized to test the bivariate relationships. “Using a family-wise type 1 error rate of 5% due to the multiplicity of tests, significant relationships are noted if $p < 0.001$ ” (Gazmararian et al., 2014, p. 226).

One-fourth of the participants were pregnant and three-fourths were postpartum. When participants were given information on enrollment, “half attempted enrollment regardless of demographic characteristics” (Gazmararian et al., 2014, p. 228). Participants were more likely to successfully enroll if they had higher education, higher

household income and lived in households with fewer than three people. The authors suggest encouraging the participants to sign up “on the spot” as the reasons for not signing up included losing the paper instructions or forgetting. Ninety-five percent read messages throughout the study and 88% planned to continue. Although, not statistically significant, the women most likely to read messages regularly were at least 26 years old “(95% [30 and older] vs. 94% [26-29 years] vs. 88% [18-25 years], $p = 0.0031$)” (p. 227).

The low income underserved pregnant and parenting women widely accepted the Text4Baby program. Additionally, the program has the potential to influence changes in behavior. The authors suggested future studies to examine the program’s impact on changing behaviors that influence pregnancy and infant outcomes.

Cormick et al. (2012) studied the cell phone access and usage, as well as health information needs of pregnant women in Argentina. A convenience sample of 146 pregnant women, 18 years or older, which had given birth to a live fetus previously. The women completed questionnaires with demographic information, technology use, and willingness to receive information through the mobile phone. The data were analyzed with the Statistical Package for Social Sciences (SPSS) and reported as means and standard deviations.

Results showed 93.2% used cellular telephones, 38.4% with the same telephone number over a year. Instead of having a contract, 74.7% used a prepaid phone. The average first phone use was at age 22.5 years, with 5.7 years standard deviation. Use of internet via cell phone was low (4.1%), whereas the majority (61%) did not consistently

use internet on the phone or computer (Cormick et al., 2012). Ninety-six percent of the women reported a desire to receive prenatal care information via text messages although at varying times throughout pregnancy. The preferred spacing of once a week text messages was noted in greater than half of the sample. The authors reported an equal number of women (87%) showed interest in phone calls with the same information (2012). Topics of interest were prenatal (90%) and infant (91%) dietary information, avoiding activities in pregnancy (92%), occasions during pregnancy to call the doctor (91%), lactation (91%), and infant skin care (95%). Physical activity in pregnancy (73%) and pregnancy to delivery progression information (64%) held the least interest (Cormick et al., 2012).

The study found women had cellular telephone access and “would be willing to be enrolled in an m-health one-way text-messaging program at their antenatal visit and receive information via text message regarding everything from prenatal/infant diet, to lactation information, to infant skin care” (Cormick et al., 2012, p. 6). Further, the preferred timing of messages was one to three times a week. Cellular telephones would therefore be an acceptable tool for prenatal support, especially with low socioeconomic levels.

Jareethum et al. (2008) conducted a randomized controlled trial to “compare satisfaction levels of antenatal care between healthy pregnant women who received short message service (SMS) via mobile phone for prenatal support, and those who did not” (p. 458). Prenatal care is an important and necessary process of pregnancy. It allows time for

assessment of mother and infant, in addition to an opportunity to talk with, reassure and educate the mother. This time and interaction provides a chance to decrease the mothers' anxiety and increase confidence. Over the course of the pregnancy the pregnant women may actually spend as few as a couple of hours with the doctor, at 10-15 minutes per visit (Jareethum et al., 2008). It is not clear if this is enough support and if women feel they are getting sufficient prenatal care.

The sample included 61 women over 18 years old, singleton pregnancy, with no complications, and gestational age less than 28 weeks at enrollment. They also owned their own mobile phone which could receive text messages. Beginning at 28 weeks and continuing through delivery, two text messages were sent per week to the study group. The messages were specific to infants' gestational age. The same prenatal care was given to both groups consisting of information and warning signs to report to the doctor. Participants completed questionnaires with satisfaction, confidence, and anxiety scores.

A chi-square was utilized for differences between group frequencies, while student *t* test compared the means between groups. The *P*-value was set at < 0.05 for statistical significance. Results indicated significantly higher levels of satisfaction, and confidence, and decreased anxiety in the study group versus the control group. No difference was found in gestational age, infant birth weight, preterm delivery or route of delivery.

Additional support during the prenatal period via text messages can be beneficial. Participants described feeling supported and well taken care of resulting in improved satisfaction with prenatal care.

A study by Pelletier et al. (2012) focused on at-risk pregnant patients within the age group in which texting is a common form of communication. To facilitate patients feeling connected to the health care team, text messages consisting of educational tips, reminders of team availability, and motivational support were implemented. Messages were sent from one to three times a week depending on pregnancy progression.

The 25 participants were enrolled, ranging in age from 14 to 32 years of age and of those, 96% were enrolled during the first or second trimester. Some messages were a one-time only while others were repeated over time. Participants completed surveys at 6 and 12 months. Nineteen surveys were completed. Results indicated the participants were satisfied with the messages and perceived them as positive and increased engagement with prenatal care. The participants felt messages needed to be personalized, provided in the appropriate language for patient engagement, and the frequency of messages was important, one to three a week.

In summary, mobile health or m-health involving the use of cellular phones to communicate, educate, support, and remind patients has been helpful in health management, with children, adolescents, and adults. Few studies have been done with pregnant women or adolescents, especially pregnant adolescents.

Summary

Pregnancy is a critical time of life and prenatal care is important for monitoring during this time. Gestational weight gain affects the infant's birth weight adversely if outside the recommended guidelines in both adult and adolescent women. Adolescents generally begin prenatal care late or do not attend all of appointments. Texting to patients has been shown to increase attendance at appointments and support behavior change in diet management and exercise. There is a gap in the research addressing pregnant adolescents' nutrition and physical activity knowledge and the use of texting and adolescent pregnancy.

This avenue of research is wide open for further exploration and understanding. More investigation is needed to identify how educational text messaging with the pregnant adolescent could influence knowledge of nutrition and physical activity and possible behavior changes resulting in healthier mothers and babies.

CHAPTER III

PROCEDURE FOR COLLECTION AND TREATMENT OF DATA

The purpose of this descriptive study with the use of a one group pretest-posttest was to describe the development of an educational text message tool/intervention for pregnant adolescents, assess the content validity of the tool/intervention, and pilot test the intervention. This design allowed for assessment of the validity and pilot testing of the educational text message intervention. This chapter presents the research methodology including research method, setting, population and sample, protection of participants, instruments, and procedure for data collection and analysis, used in this study.

Research Method and Procedure

Text Message Tool Development

The purpose of this study was to develop an educational text message intervention for pregnant adolescents, assess the content validity of the intervention, and pilot test the intervention. The researcher developed the text messages focusing on nutritional and physical activity guidelines for pregnancy based on recommended guidelines from professional resources, such as the AAP, ACOG, AND, and IOM, current literature, and professional experience working with pregnant women and adolescents. The idea for the messages evolved from over 30 years clinical experience working with pregnant women and adolescents in all areas of perinatal care and over 25 years teaching experience with nursing students in the perinatal area. Selection of message content occurred after

recommended guidelines and current literature were reviewed. After the text message intervention was created, the readability of the messages were evaluated by the Flesch-Kincaid readability tool and adapted to the 6th grade level or below.

Subject Matter Expert Evaluation

After leveling of the messages, professional subject matter experts (SMEs) were selected to evaluate the intervention for content validity. The professional SMEs included an obstetrician, an obstetric nurse practitioner, two educators (one was a nurse and perinatal educator and one taught at the primary and secondary level), and two registered dietitians (one worked in a hospital and taught at the university level and one worked in a hospital with perinatal women's health patients). Each professional subject matter expert scored each text message item on relevancy, sufficiency, and clarity. After suggested changes were made, they reviewed the items again for correct intent of the changes. Once approval was obtained the messages were taken to focus groups for review.

Focus Groups

After review by professional SMEs, the text messages were reviewed for relevancy and clarity in two focus groups, each comprised of eight pregnant and parenting adolescents aged 16-19 years of age. The focus group participants were recruited from a pregnant and parenting school for pregnant adolescents. The focus groups were asked for feedback on the items regarding the relevancy of the content to being pregnant, if the items were clearly written in understandable language, what should be changed, or how the messages could better suit the population of pregnant adolescents.

Continuous analysis was utilized and adjustments made in the questions and discussion from the first group to the second group (Krueger & Casey, 2009). The transcripts from each focus group were analyzed using the constant comparative method. Revisions were made to the items based on feedback from the focus groups and evaluation of the comments then sent back to the SMEs for final agreement and approval.

Pilot Study

After final approval from SMEs, pilot testing of the intervention was conducted using a descriptive one group pretest-posttest method. According to Portney and Watkins (2009) “descriptive studies document the nature of existing phenomena and describe how variables change over time” (p. 301). The one group pretest-posttest design seeks to determine the effect of the treatment “by measuring the difference between pretest and posttest scores” (p. 223).

In the pilot study, the texting intervention was the independent variable. The dependent variable, the knowledge of nutrition and physical activity scores were assessed through a pretest-posttest. A convenience sample of participants from pregnant adolescents attending a public school for pregnant and parenting adolescents was recruited for the pilot study. The participants were pregnant adolescents aged 16-19 years. A pre-test assessment of nutrition and physical activity knowledge was administered after informed consent was obtained. An intervention of twice weekly educational text messages was delivered for eight weeks, followed by the post-test administration. Differences in pre- and post-test scores were analyzed.

Setting

The setting for the focus groups and pilot testing data collection was a public school for pregnant and parenting adolescents in Tulsa, Oklahoma. The focus groups and pretest-posttests were conducted at a convenient time for the adolescents, at the school in a private area by the lunchroom. The area had a relaxed atmosphere, tables and chairs. The texting intervention was delivered through the participants' personal cellular device on Monday and Thursday at 4 p.m. each week for a period of eight weeks.

Population and Sample

A convenience sample of participants from a population of pregnant or parenting adolescents was used. This sampling technique was selected to facilitate contact with the specific subjects required for the study.

Focus Group

For the focus groups, a sample size of 8-10 participants was needed in each group. Inclusion criteria for the focus group participants were: (a) be able to read and speak English, (b) age 16 to 19 years, (c) be pregnant or parenting at the time of consent, and (d) consent to participate in the study. Exclusion criteria for the focus groups were: (a) inability to speak and read English, (b) younger than 16 or older than 19 at enrollment, or (c) do not consent. Each focus group consisted of eight participants, for a total of 16 participants, aged 16-19 years old.

Pilot Study

Inclusion criteria for the pilot study were: (a) be able to read and speak English, (b) age 16 to 19 years, (c) be pregnant at the time of consent, (d) have a mobile phone capable of receiving text messages, and (e) consent to participate in the study. Exclusion criteria were: (a) inability to speak and read English, (b) younger than 16 or older than 19 at enrollment, (c) never been pregnant, (d) do not own a mobile phone capable of receiving text messages, or (e) do not consent.

For the pilot study, an estimate of the sample size needed, according to Polit and Beck (2008) and Cohen (1992) requires information about the significance criterion, α ; power $[1-\beta]$; effect size (ES); and sample size, n .

Significance level for the pilot study was set at $\alpha = .05$, which is the “conventional standard for Type I error” according to Portney and Watkins (2009, p. 422). The power of .80 was used, where $\beta = .20$ (a 20% chance of making a type II error), $1-\beta$ with an 80% probability “that we would correctly demonstrate a statistical difference and reject H_0 ” according to Portney and Watkins (2009, p. 422), who further state this “represents a reasonable protection against Type II error” (p. 422). A review of the literature yielded few studies with an effect size; Petrie et al. (2011) used an effect size of .6 with power of .80 and found significant results. According to Cohen, for the t test with two independent means use an effect size of .20 (small), .50 (medium), or .80 (large effect). Polit and Beck (2008) state that with a “reason to expect that the independent and dependent variables will be strongly related, then a relatively small sample should be adequate” (p.

350). Although few effect sizes were identified for similar studies, the literature did support a significant relationship between texting and management of a medical condition (Petrie et al., 2011). Therefore, the effect size of .80 was used based on Cohen (1992) and Polit and Beck (2008). A G-power analysis of statistical tests to be performed indicated a total sample size of 100 with an effect size of 0.5, $\alpha = .05$, and power at .80 or a total sample size of 40 with an effect size of 0.8, $\alpha = .05$, and power at .80. Based on the above information, G-power evaluations, and the table presented by Cohen (1992, p. 158), the sample size of 40 was sought, with the values as set above and an additional 10 to cover attrition.

Protection of Human Participants

Institutional Review Board (IRB) approval was obtained, prior to beginning the study, from Texas Woman's University (TWU) and from both sites of the public school program for pregnant and parenting adolescents if required. All participants completed informed consent processes prior to participation in the focus groups and the testing of the text message tool.

Informed Consent

Consent forms describing the study, focus groups and testing the texting tool, and the possible risks and benefits involved were reviewed and signed by voluntary participants. The researcher disclosed the potential benefits and risks to the participants through the consent forms was available to answer questions.

Risks of Participation

Participation in this study involved three potential risks: (a) loss of confidentiality, (b) loss of anonymity, (c) risk of coercion. Measures were taken to minimize these risks as listed below:

Loss of confidentiality. The participants' confidentiality was protected through the utilization of assigned numbers on the demographic form and questionnaires. Only the researcher will have access to a master list of assigned identification numbers and participants for outcome data collection.

Loss of anonymity. In addition to following the confidentiality process in data collection, the focus groups and pre-post testing were conducted in a private area by the lunchroom. The participants' anonymity was further protected through anonymous presentation of results, and in aggregate form only.

Risk of coercion. The participants were protected from coercion through carefully explaining prior to the beginning of the study that participation is voluntary, and they can withdraw from the study without repercussion or penalty at any time.

Benefits of Participation

There are no direct benefits to the participants.

Instruments

Three instruments were used in this study; a demographic form, a subject matter expert rating form for each intervention item, and a 20 item self-report nutrition and physical activity screening tool.

Demographic Form

The demographic form was completed by the participants in the focus groups and in the pilot study. The form utilized with the focus group participants had an assigned identification number for each participant and requested information on study site, age, estimated due date, number of times has been pregnant (gravida) number of times has given birth (para), marital status, ethnic group, whether English is a primary or second language, and the last grade completed. The form utilized with the pilot study participants included all the information as the focus groups with the additional information concerning the living arrangements of the participant and age of the individual with whom they were living, a 10 digit mobile telephone number, and a backup telephone number. The demographic forms were completed after informed consent was obtained and prior to beginning the focus groups and pretest for the pilot study. (Appendix D)

Text Message Intervention

The educational text messages were developed by the researcher based on recommended guidelines and current literature. The educational text messages were concise, targeted to nutrition and physical activity during pregnancy and written at the sixth grade or lower reading level as measured by the Flesch Kincaid readability tool. The intervention initially consisted of 29 messages that were reduced down to 26 through the process of evaluation by the SMEs and focus groups. The final version of the intervention consisted of 26 messages, of which 16 were utilized during the pilot study. (Appendix E). Based on the literature (Cormick et al., 2013; Pelletier et al., 2012)

participants prefer 1-3 texts per week. Timing of the intervention was set at twice a week in agreement with the literature and to decrease risk of overloading the participants. According to Woolford et al. (2010) stated participants felt 4:00 p.m. was an appropriate time of day to receive messages. Messages were sent at 4:00 p.m. in agreement with the literature and to facilitate the participants being able to get out of school and be less busy before receiving the messages.

The time frame of the intervention prevented all messages from being utilized. Ten messages were selected to be omitted based on the content; numbers 16-21 focused more on prenatal care than specific nutrition information; number 15 focused more on a recipe than basic nutrition information; number two and four focused more on timing of meals and fluids than on specific nutrition information; and number 25 focused less on a specific exercise and had initially been a little confusing to the focus group. The remaining 16 messages were sent at a rotation of three nutrition to one physical activity. This rotation was utilized to facilitate interest by mixing the physical activity messages, which had a fewer number of messages, evenly in with the nutrition focused messages. This also simulates the idea of mixing eating healthy in with being physically active. Each message was only sent once, and all participants received the same messages at the same time. The texts contained information for pregnant adolescents to use as desired with no response to the researcher required. The researcher asked the participants to send a brief text of 'OK' indicating they had opened and read each text, and received a verbalized agreement.

Subject Matter Expert Rating Form of Text Messages

The SME rating form was utilized to evaluate the content validity of each educational text message developed by the researcher. The tool listed each of the 29 items with an area to rate each item in all three categories of relevancy, sufficiency, and clarity on a 4-point Likert type scale. The options for relevancy were: 1= not relevant, 2= somewhat relevant, 3= relevant, and 4= extremely relevant. The options for sufficiency were: 1= not sufficient, 2= somewhat sufficient, 3= sufficient, 4= extremely sufficient. The options for clarity were: 1= not clear, 2= somewhat clear, 3= clear, 4= extremely clear.

A mean content validity ratio (CVR) score across items may be used as an indicator of content validity (Lawshe, 1975). As greater numbers of professional SME's agree an item is essential (rated at a 3 on relevant, sufficient, and clear), higher levels of content validity exists. The possible CVR range was -1 to + 1, with the positive numbers indicating validity. The equation was $CVR = n - (N/2) / N/2$; where n equaled the number of SMEs rating the item at essential or higher and N equaled the total number of SMEs completing the evaluation. The scoring of the tool was accomplished by identifying the number of SMEs that rated each item at a 3 or above, then completing the equation for CVR. On this tool, a score of .33 or greater indicated greater than half of the SMEs rated the item as essential or greater and the item had content validity. (Appendix F)

Nutrition and Physical Activity Tool

The Family Nutrition and Physical Activity (FNPA) screening tool, developed by Ihmels and Welk (Ihmels et al., 2009) from Iowa State University in collaboration with the American Dietetic Association, was utilized to measure nutrition and physical activity behaviors in the participants. The individual completing the questionnaire marks one of the options according to the words identified: almost never, sometimes, usually, and almost always. The possible score of 20-80 is then calculated by adding a value of 1-4 from left to right for each item, except for items that are reverse coded (3, 4, 5, 7, and 13), which are added from 4-1 from left to right. The tool contains 10 factors with two questions capturing each factor for a total of 20 items. The total score correlated with the environment and risk of obesity as measured by the child's body mass index (BMI). Higher scores indicated favorable environment and lower risk for being overweight or at risk of overweight. This tool has been used widely in grade schools and is currently being adapted for use in other areas. The alpha reliability was 0.72 for the instrument with two confusing questions removed and with the original 21 questions, the reliability was 0.70. Content validity was established. (Appendix C)

The instrument and the texting intervention align in part or all of eight of the 10 construct areas. The instrument constructs addressed were: (1) family meals, (2) food choices, (3) beverage choices, (4) restriction/reward, (5) healthy environment, (6) family activity, (7) child activity, and (8) sleep rest. See Table 1 for specific items.

Table 1

Alignment of Instrument Questions and Intervention Items

Instrument Question	Intervention Items
1 – breakfast	2 – eat 3 meals
6 – fruits, vegetables	1, 5, 7, 9, 13, 14, 15 – fruits and vegetables
7, 8 – soda, sugary drinks, milk	3, 4 – drink water, decrease caffeine
9, 10 – eating junk food	11 – decrease high calorie and fat foods
14, 15, 16, 17 – physical activity	22, 24, 25, 26 – physical activity
19, 20 – sleep, rest	23 – sleep

The search for an instrument that measured the knowledge of nutrition and physical activity in pregnant women yielded several choices. These identified instruments were utilized by various agencies working with pregnant women, such as health departments, and children's agencies. After contacting these agencies, however, it was established the instruments did not have reliability and validity established. Therefore, the decision was made to utilize the FNPA as it addressed many of the areas of interest in this study and had established reliability and validity. Permission was obtained to use the instrument and to adapt the wording from the 'My family/My child' language to 'I' and use with the pregnant adolescent sample. The established reliability no longer applies to the instrument after adaptation of the language and with utilization of the instrument in a different population.

Data Collection

After obtaining IRB approval from Texas Woman's University recruitment and data collection began. The method of recruitment and data collection are described in detail in the following sections. Additionally, the implementation of the intervention is described as well as the method of handling missing data.

Recruitment

Recruitment for participants occurred in three phases. Initially the professional subject matter experts were recruited, followed by the adolescent subject matter experts for the focus groups, and finally the pregnant adolescent participants in the pilot study.

Professional subject matter expert. The professional SMEs were personally recruited by the researcher from local obstetrician offices, local hospital dietitians, Women's, Infants, and Children (WIC) offices, high school educators and perinatal educators in the area. The experts in each area were approached by the researcher for availability and interest in the study. The resulting group of professional SMEs consisted of one obstetrician, one women's health nurse practitioner, one registered dietitian from a local hospital who also teaches at the university level, one registered dietitian from a local hospital that specifically works with the perinatal women's health patients, one nurse and perinatal educator, and one educator at the primary and secondary level. The study, the role, and the requirements of the subject matter expert was explained, with time allowed for questions and discussion. Verbal consent was obtained prior to distributing the SME Rating form for evaluation.

Focus group. The focus group members of pregnant and parenting adolescent SMEs were recruited by the researcher from a public school for pregnant and parenting adolescents. The recruitment occurred during the study hour at the school. The study was described, explaining the inclusion criteria and that participants would be placed in one of two focus groups where they would evaluate the educational text messages. The students who met the criteria and who were interested were given informed consents and demographic forms. The consent form was explained, including the risks and benefits. All participants had the opportunity to ask the researcher questions before consent was obtained. The dates and times of the focus groups were identified. The informed consent was then obtained and the participants completed the demographic form and submitted to the study hall teacher. The researcher obtained the forms the next day. The recruited focus group participants included 14 pregnant and two parenting adolescents. This process was repeated at both sites of the school.

Pilot test. Participants meeting inclusion criteria for the pilot testing were recruited by the researcher from both sites of a public school for pregnant and parenting adolescents. Two local perinatal clinics with historically large adolescent populations were approached to allow recruitment of participants although access was denied. The recruitment at the schools occurred during study hall. The steps of the study was described, including a pre and posttest and twice weekly text messages for eight weeks between tests. The consent form was explained, including the risks and benefits. All participants had the opportunity to ask the researcher questions before consent was

obtained. Those participants wishing to participate were asked to sign the consent form and complete the demographic form. The desired sample size was set at 40 participants, based on an $\alpha = .05$, the estimated power of .80 and estimated effect size of .80. Initially a sample of 13 was obtained between the two sites. Recruitment of potential participants for the pilot testing was ongoing through the eight week trial study at both sites. No new students enrolled at one site, while 3 new participants enrolled at the other site. They did not fit the inclusion criteria, one did not speak English, one did not have a phone, and the third delivered days after enrolling.

Data Collection

Subject matter expert form. The educational text messages which focused on nutrition and physical activity during pregnancy were evaluated for relevancy, sufficiency, and clarity by professional SMEs and pregnant adolescents. After recruitment of each professional SME, the SME Educational Text Message Rating Form was explained and given to the expert with a self-addressed, stamped return envelope. Each item was reviewed by the professional SMEs for relevancy, sufficiency, and clarity and given a rating of 1-4 in each category. After review and rating, the items were scored. The scoring of the tool was accomplished by identifying the number of SMEs that rated each item at a 3 or above, then CVR was completed. On this tool, a score of .33 or greater indicated greater than half of the SMEs rated the item as essential or greater and the item had content validity. The items were revised as the SMEs indicated. Two items were deleted for a score of less than .33 in the category of sufficiency and two items which

were very similar were combined into one. The intervention initially consisted of 29 messages that were reduced down to 26 through the process of evaluation by the SMEs.

Focus group. The 26 revised items were discussed by the focus group members consisting of pregnant adolescent SMEs. Each group met one time for an hour in a private area by the lunchroom during the lunch period. Continuous analysis was utilized during the focus groups where suggestions from the first groups were brought up in the second group, specifically the request for examples of foods in several items. The feedback from each focus group was evaluated for themes and the items revised as indicated. The professional SMEs reviewed and approved the revised items a final time before pilot testing began.

Pilot test with FNPA. After obtaining consent from the intervention pilot testing participants, the adapted FNPA was administered as the pretest. The following Monday the intervention began and a message was sent twice a week for eight weeks. The FNPA was administered as the posttest on the day following the last text message. Both pre and posttests were administered at the school in a private area by the lunchroom. Analysis of pretest and posttest scores differences were evaluated after completion of the testing utilizing the Wilcoxon Signed Ranks test.

Intervention

The educational text message intervention consisted of sending the pregnant adolescent a twice weekly text message for eight weeks. The text messages were based on current research and landmark guidelines (AAP & ACOG, 2007; AND, 2014; Barger,

2010; IOM (2009); Juhl, Kogevinas, Andersen, Andersen, & Olsen, 2010; Prather, Spitznagle, & Hunt, 2012; Ruchat et al., 2012; United States Department of Agriculture, 2011; Widen & Siega-Riz, 2010). The messages were reviewed by subject matter experts for content validity prior to implementation. The process of SME review by obstetric, education, dietitian, and pregnant adolescents is described above.

The intervention participants received twice weekly text messages, which were sent to their personal mobile telephone every Monday and Thursday at 4:00 p.m. for eight weeks. Timing of the intervention was set at twice a week in agreement with the literature and to decrease risk of overloading the participants. According to Cormick et al. (2013) and Pelletier et al. (2012) participants prefer 1-3 texts per week. Monday was selected to start the week and Thursday was selected as it is right before the weekend. The messages were sent at 4:00 p.m. in agreement with the literature and to facilitate the participants being able to get out of school and be less busy before receiving the messages. According to Woolford et al. (2010) participants felt 4:00 p.m. was an appropriate time of day to receive messages. The FNPA pretest-posttest was administered before and after the intervention at each school in a private area by the lunchroom.

Missing Data

The opportunity for missing data may occur between timing of pretest-posttests and adolescents dropping out of the study. A plan to deal with the missing data is necessary to identify when sampling is complete and so data analysis can proceed appropriately. When less than 25% of the data are missing, the data may be substituted

with the most typical response (Polit & Beck, 2008). The mean item value for all of the participant responses for the specific missing item is calculated and substituted so the score for the scale can be computed. If as much as 25% to 40% of the data are missing, it is recommended that the variable be deleted for all participants. The statistical program Statistical Package for the Social Sciences (SPSS) was used for analysis and had a procedure within the program which estimates the value of the missing data, had it been needed. These guidelines were planned for the analysis of the pilot data although they were not needed in this study. All 13 participants fully completed the pre and posttests. Since there was no missing data, these guidelines were not utilized.

Treatment of Data

To insure the inferences made from the statistical analysis of the data accurately represented the findings, the researcher addressed the assumptions of each statistical test utilized. Assumption for the paired samples *t* test included normally distributed difference scores (Green & Salkind, 2005). To test for the assumption of normal distribution, a frequency distribution was conducted on the data and a histogram was created. (Munro, 2005; Polit & Beck, 2008).

The computer software statistical package SPSS version 19.0 (or later) was used to assist with data analysis. The alpha was set at .05. Descriptive statistics were used to describe the sample. According to Portney and Watkins (2009), a *t* test is utilized “for evaluating the comparison between two means...can be applied to differences between two independent samples or between scores obtained with repeated measures” (p. 433).

The *t* test for paired samples was planned to test for the difference in performance of the same group of participants on the pretest-posttest. The participants are “used as their own controls, exposing each subject ... conditions and then comparing their responses across these conditions...tests of significance involving paired comparisons tend to be more powerful than unpaired tests” (p. 445). The *t* test for paired samples was not conducted on the pilot test data due to the violation of the normal distribution assumption. The histogram indicated a bi-modal distribution of the pre and posttest scores. Non-parametric tests are utilized in cases of small samples and distortions of the data (Munro, 2005). The Wilcoxon Signed Ranks test, comparable to the parametric paired *t* test, was utilized for analysis of the pretest-posttest scores.

Summary

This chapter presented the procedures for collection and treatment of data for the study conducted to develop and test an educational text message intervention focusing on nutrition and physical activity for pregnant adolescents. Issues related to the design, intervention development, participant selection, setting, sample size, protection of human subjects, instrument description, including reliability and validity, data collection techniques and data treatment were discussed.

CHAPTER IV

ANALYSIS OF DATA

The purpose of this study was to develop an educational text message tool/intervention for pregnant adolescents based on feedback from subject matter experts and pregnant adolescents. There were three phases of the study: working with subject matter experts to assess the validity of the instruments, focus groups with pregnant adolescents to assess the suitability of the intervention with the target population, and pilot testing the intervention using a one group pre-test post-test design.

Pregnant adolescents tend to seek prenatal care late (after the first trimester) or not at all, miss prenatal appointments, have problems with weight gain during pregnancy, and deliver low or high birth weight babies (CDC, 2000; CDC – Birth Weight, 2013; Harper et al., 2011; Ludwig & Currie, 2010; March of Dimes, 2011; Perron et al., 2010; Wilson et al., 2012). It is unclear if adolescents have knowledge about nutrition and physical activity to keep gestational weight gain within recommended guidelines (Institute of Medicine, 2009; Lucas et al., 2014). The study aimed to develop a literature based nutrition and physical activity focused educational text message tool for use with pregnant adolescents.

Chapter IV presents a description of the sample, the findings of the educational text message tool evaluation and validation process, and results of the educational text message tool pilot. The chapter concludes with a brief summary of the findings.

Description of Sample

A different sample was used for each phase of this study, resulting in three groups. The first sample group consisted of the professional subject matter experts (SMEs). The professional SMEs were personally recruited by the researcher from local obstetrician offices, local hospital dietitians, Women's, Infants, and Children (WIC) offices, high school educators and perinatal educators in the area. The initial evaluation of the intervention materials for content validity was completed by SMEs. The group included one obstetrician, one woman's health nurse practitioner, two registered dietitians (one who is employed at a hospital and works with patients in women's health and one employed at a hospital and teaches at the college level) and two educators (one is a nurse who works with pregnant women and one who taught in primary and secondary education).

The second sample group, representatives from the target population, included pregnant and parenting adolescents who will ultimately use the intervention. This convenience sample formed the focus groups of adolescent SMEs. The adolescents were considered SMEs on the topic of adolescents and what was considered relevant to adolescents. The focus group members were recruited by the researcher from two sites of a public school for pregnant and parenting adolescents.

Focus groups were conducted with pregnant and parenting adolescents to elicit their responses to the intervention. The focus groups consisted of 16 participants, two groups of eight participants each. All participants were between 16 and 19 years old.

Table 2 and Table 3 present the descriptive data. Most participants, 14 (87.5%), were in their first pregnancy, while two (12.5%) had delivered and were parenting. The gestational age of the 14 pregnant participants ranged from 14 weeks to 37 weeks (see Table 2 for distributions).

Table 2

Descriptive Results for Focus Group Age and Gestation

Measure	Age	Gestation in weeks during focus group
N	16	14
Mean	17.06	27.21
Median	17.00	28.00
Std. Deviation	.772	7.68

Table 3

Frequency Analysis of Focus Group Demographics

Demographic item	n	%
Age		
N = 16		
16	3	18.8
17	10	62.5
18	2	12.5
19	1	6.3

(Continued)

Ethnicity		
Caucasian	9	56.3
African American	1	6.3
Hispanic	4	25.0
American Indian	1	6.3
Asian Hmong	1	6.3
Last Grade Completed		
Eight grade	1	6.3
Ninth grade	2	12.5
Tenth grade	10	62.5
Eleventh grade	3	18.8
English as Second Language		
Yes	4	25.0
No	12	75.0

All participants were in high school, with the last grade completed ranging from eighth to eleventh, as described further in Table 3. As seen in Table 3 and Figure 2, the participants self-identified into five ethnic groups. A limited number of participants self-identified as speaking English as a second language; descriptive analysis is presented in Table 3. Most of the participants, fifteen (93.8%) were single and one (6.3%) was married.

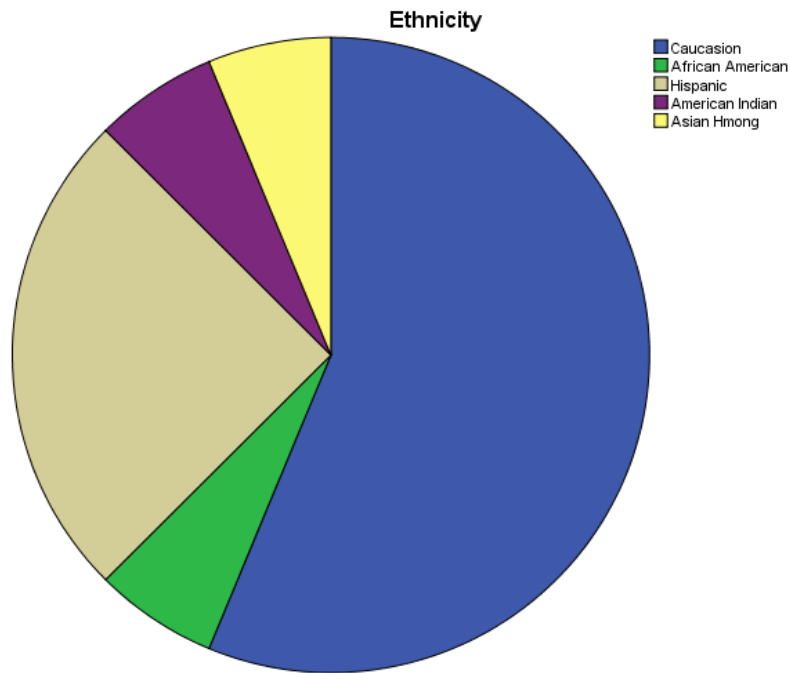


Figure 2. Frequency distribution of ethnicity in the focus groups

The third sample group, representatives from the target population, included pregnant adolescents recruited for the pilot study. The participants were recruited by the researcher from two sites of a local school for pregnant and parenting mothers. The students who attend this school are from the local public schools who prefer to be in an environment supportive of the changes pregnant adolescents' experience. All participants were in their first pregnancy at the beginning of the pilot study. Participants were between 16 and 18 years old, see Table 4, and Table 5 for further descriptions. The beginning gestational age of the 13 participants ranged from 14 weeks to 37 weeks, while the ending gestational age of the participants included ten participants who ranged from

22 weeks to 40 weeks, and three participants who had delivered (see Table 4 additional descriptive data).

Table 4

Descriptive Results for Adolescents' Age and Gestational Age at the Start and Finish of the Intervention

Measure	Age	Gestation in weeks at Start	Gestation in weeks at Finish
Mean	16.92	27.38	32.70
Median	17.00	28.00	35.50
Std. Deviation	.641	7.96	6.93

As seen in Table 5, the last grade completed by the participants ranged from eighth to eleventh. The participants came from a variety of ethnic groups, with several self-identifying as speaking English as a second language (see Table 5 for additional descriptors). Most of the participants, twelve (92.3%), were single and one (7.7%) was married. Descriptions in Table 5 and Figure 3 show the living arrangements of the participants which varied from most living with someone and two living alone. The ages of the person with whom the participants were living ranged from 17 to 51 years old.

Table 5

Frequency Analysis of Intervention Group Demographics

Demographic item		n	%
Age			
N = 13	16	3	23.1
	17	8	61.5
	18	2	15.4
Ethnicity			
	Caucasian	6	46.2
	African American	1	7.7
	Hispanic	4	30.8
	American Indian	1	7.7
	Asian - Hmong	1	7.7
Last grade completed			
	Eight grade	1	7.7
	Ninth grade	2	15.4
	Tenth grade	8	61.5
	Eleventh grade	2	15.4
English as second language			
	Yes	4	30.7
	No	9	69.3
Living arrangements			
	Mother	4	30.8
	Parents	4	30.8
	Alone	2	15.4
	Significant Other	2	15.4
	Other - Aunt	1	7.7

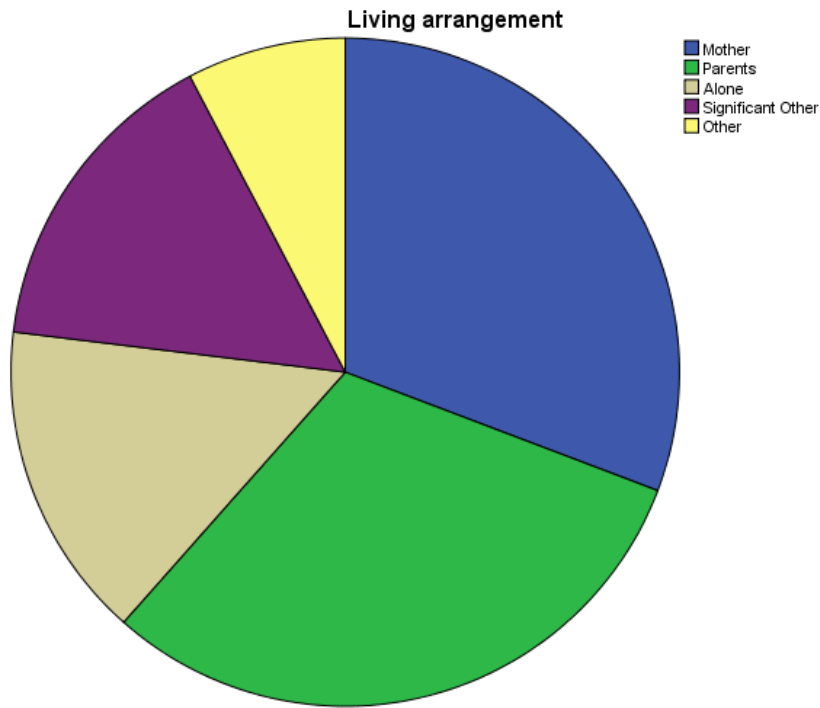


Figure 3. Frequency Distribution of Intervention Group Adolescent Living Arrangements

Five potential participants were excluded due to age, four under 16 years (14) and one over 19 (20). Two potential participants were excluded due to not having a mobile phone and one was excluded due to not speaking English.

Findings

The research questions that guided this study were: what is the content validity of the researcher developed, text messaging intervention and how does an educational text message intervention influence pregnant adolescents' knowledge of nutrition and physical activity? Findings related to these are addressed here.

Subject Matter Expert

To address the first research question, “What is the content validity of the researcher-developed text messaging intervention”, the researcher sought the opinions of professional subject matter experts (SME). The group of professional SMEs consisted of one obstetrician, one women’s health nurse practitioner, one registered dietitian from a local hospital who also teaches at the university level, one registered dietitian from a local hospital that specifically works with the perinatal women’s health patients, one nurse and perinatal educator, and one educator at the primary and secondary level. The professional SMEs initially evaluated each of the original 29 educational text messages (hereafter referred to as items) for relevancy, sufficiency and clarity. A 4-point scale was used on which 1= not relevant, sufficient, or clear; 2 = somewhat relevant, sufficient, or clear; 3 = relevant, sufficient, or clear; and 4 = extremely relevant, sufficient, or clear. According to Lawshe (1975), a mean content validity ratio (CVR) score across items may be used as an indicator of content validity. As greater numbers of SMEs agree an item is essential (rated a 3 on relevant, sufficient, and clear), the item has stronger levels of content validity. The possible CVR range was -1 to + 1, with the positive numbers indicating validity. The equation was $CVR = n - (N/2) / N/2$; where n equaled the number of SMEs rating the item at essential or higher and N equaled the total number of SMEs completing the evaluation. The items were scored and the CVR evaluated for each item in each area of relevancy, sufficiency, and clarity, see Table 6 for item scores. If any item scored lower than .33 it was deleted. This resulted in two items (15 & 16) being

dropped from the messages with scores of less than .33 under the category of sufficiency. Additionally, two SMEs made suggestions for clarifying the wording on 11 items and combining two items (24 & 27). The scoring of the items for relevancy resulted in 23 (79.3%) at +1, five (17.2%) at .66, and one (3.4%) at .33. Scoring for sufficiency resulted in 10 (34.4%) at +1, 15 (51.7%) at .66, and one (3.4%) at .33. Scoring for clarity resulted in 12 (41.3%) at +1, 12 (41.3%) at .66, and 5 (17.2%) at .33. All were above .33, with the majority of 45 (51.7%) at +1. The items were adapted based on the suggestions. The resulting 26 items were sent back to the SMEs for review of correctness of intended changes. All SMEs agreed the content and intended changes were correct. The items were reviewed again by the SMEs following revisions based on feedback from the focus groups with continued agreement responses received regarding content.

The time frame of the intervention prevented all messages from being utilized. Ten messages were selected to be omitted based on the content; numbers 16-21 focused more on prenatal care than specific nutrition information; number 15 focused more on a recipe than basic nutrition information; number two and four focused more on timing of meals and fluids than on specific nutrition information; and number 25 focused less on a specific exercise and had initially been a little confusing to the focus group. The remaining 16 messages were sent at a rotation of three nutrition to one physical activity. This rotation was utilized to facilitate interest by mixing the physical activity messages, which had a fewer number of messages, evenly in with the nutrition focused messages. This also simulates the idea of mixing eating healthy in with being physically active.

Table 6

Content Validity Ratio Scores of Subject Matter Expert Tool

Item	Relevancy	Sufficiency	Clarity
1	1	.66	.66
2	1	1	1
3	1	.66	.66
4	1	.66	.66
5	1	.33	.33
6	1	.66	.66
7	1	.66	.66
8	1	.66	.33
9	1	1	1
10	1	1	1
11	1	.66	.33
12	1	1	1
13	.66	.66	.66
14	1	.66	.66
15	.66	0	.33
16	.33	0	.33
17	1	.66	.66
18	1	1	1
19	1	1	1
20	.66	1	1
21	1	1	1
22	1	1	1
23	1	1	1
24	1	.66	.66
25	.66	.66	.66
26	1	1	1
27	1	.66	.66
28	1	.66	1
29	.66	.66	.66

Focus Groups

The second sample group was comprised of pregnant and parenting adolescents to represent the end user of the intervention. The focus group members were recruited by the researcher from a public school for pregnant and parenting adolescents. The recruitment occurred during the study hour at the school. The focus group participants were considered SMEs on adolescents and what adolescents would consider acceptable. The participants were age 16-19 years, able to read and speak English, pregnant or parenting at the time of consent, and consented to participate in the study. Two focus groups were conducted with eight participants each for a total of 16 participants. Both groups reviewed each of the 26 educational text message items for relevancy, clarity, and suitability for the population of pregnant adolescents. Continuous analysis was utilized and adjustments made in the questions and discussion from the first group to the second group (Krueger & Casey, 2009), such as examples of various types of food and clarification of one term, psychosocial, which was changed to thoughts and emotions. The transcripts from each focus group were analyzed using the constant comparative method. The feedback from each focus group was evaluated for themes and the items revised as indicated. Consistently, the comments from both groups were that no additional information was needed for the population of pregnant adolescents. Both groups indicated the items were written in language that was understandable for the population of interest, pregnant adolescents. The first group suggested adding examples for some of the foods such as green vegetables, fruit, and fish so they would know

specifically what to eat. This applied to items 5, 7, 8, 9, 10, with participants repeatedly asking, “What are some examples?” During the second focus group, with examples given for the items, participants made comments such as, “Ok, I can eat that” or “Are there more examples?” A participant in the second focus group asked to have the word psychosocial defined. Feedback from both focus groups indicated that pregnant adolescents would be comfortable receiving these text messages. Comments on individual items included “Ok”, “I would listen to that”. The comment that best summarizes the response to all of the items combined was, “They tell you stuff and aren’t preachy”.

The second research question was: How does an educational text message intervention influence pregnant adolescents’ knowledge of nutrition and physical activity? This question was partially addressed with a one group, pre-test post-test pilot study. The pilot study consisting of sending a message, from the educational text message intervention, twice a week for eight weeks is described here.

Pilot Study

The third sample group, consisted of pregnant adolescents recruited by the researcher from a public school for pregnant and parenting adolescents. The recruitment occurred during the study hour at the school. The participants took the FNPA pretest and posttests before and after the text message intervention. Prior to beginning the intervention, the participants were asked to return text ‘OK’ to the researcher after

opening and reading the text messages, and verbal agreement was given, see Table 7 for the ‘read’ rate.

During the time with the participants immediately after the administration of the posttest, the participants provided unsolicited comments to the researcher related to the intervention. Several of the comments were positive and expressed satisfaction with the intervention. Comment samples are presented in Table 8.

Table 7

Participant Text Message ‘Read’ Rate

Message Number	Item Number	Number of Responses	Percent
1	1	9	69.2
2	3	5	38.4
3	5	5	38.4
4	22	4	30.7
5	6	5	38.4
6	8	5	38.4
7	7	6	46.2
8	26	5	38.4
9	10	4	30.7
10	13	5	38.4
11	12	5	38.4
12	24	4	30.7
13	14	5	38.4
14	11	4	30.7
15	23	4	30.7
16	19	5	38.4

Table 8

Unsolicited Comments from Participants Regarding the Intervention

Comments
“The information in the texts were helpful!”
“It helped having examples.”
“Thanks, it was nice getting reminders”
“I didn’t know to eat some of that stuff”
“One time I was eating what the text said!”

An adapted version of the Family Nutrition and Physical Activity (FNPA) screening tool (Ihmels, Welk, Eisenmann, & Nusser, 2009) was planned as the pretest posttest to measure participant knowledge of nutrition and physical activity before and after the educational intervention. In actuality, the tool is a behavioral based screening tool for risk of obesity and the researcher was not measuring knowledge. The purpose of the instrument was to have a simple self-rated screening tool for parents to answer and identify at risk environments and behaviors. The questions and total score of the instrument identified behaviors of a favorable or unfavorable environment which increase or decrease risk of obesity. The alpha reliability was 0.72 for the instrument with two confusing questions removed and with the original 21 questions, the reliability was 0.70. Content validity was established and average construct validity was 0.24. Permission was obtained to use the instrument and to adapt the wording from the ‘My family/My child’

language to 'I' and use with the pregnant adolescent sample. The established reliability no longer applies to the instrument after adaptation of the language and with utilization of the instrument in a different population. The instrument was utilized as the pretest posttest assessment to identify if the posttest scores, behavior, changed after receiving the text message intervention.

The FNPA tool consisted of 20 items, rated on a 4-point Likert-type scale. The individual completing the questionnaire marks one of the options according to the words identified: almost never, sometimes, usually, and almost always. The possible score of 20-80 is then calculated by adding a value of 1-4 from left to right for each item, except for items that are reverse coded (3, 4, 5, 7, and 13), which are added from 4-1 from left to right. The tool contains 10 factors with two questions capturing each factor for a total of 20 items. The total score correlated with the environment and risk of obesity as measured by the child's body mass index (BMI). The instrument and the texting intervention align in part or all of eight of the 10 construct areas. The instrument constructs addressed were: (1) family meals, (2) food choices, (3) beverage choices, (4) restriction/reward, (5) healthy environment, (6) family activity, (7) child activity, and (8) sleep rest. See Table 9 for specific items.

Higher scores indicate more favorable environment and behaviors thus a lower risk for being overweight or at risk of overweight. The pre and posttest were scored by adding the points, as described above, for the questions in groups of two which represent the constructs, then adding all of the 10 construct points together. With this additional

breakdown of scores, specific areas of risk which had low scores can be targeted. All participants completed all 20 items in the pre-posttests, resulting in no missing data to be discussed, see Table 10 for participant pre and posttest scores. Pretest scores ranged from 41-61, while posttest scores ranged from 48-62, see Table 11 for further descriptive statistical details.

Table 9

Alignment of Instrument Questions and Intervention Items

Instrument Question	Intervention Items
1 – breakfast	2 – eat 3 meals
6 – fruits, vegetables	1, 5, 7, 9, 13, 14, 15 – fruits and vegetables
7, 8 – soda, sugary drinks, milk	3, 4 – drink water, decrease caffeine
9, 10 – eating junk food	11 – decrease high calorie and fat foods
14, 15, 16, 17 – physical activity	22, 24, 25, 26 – physical activity
19, 20 – sleep, rest	23 – sleep

Table 10

Participant FNPA Pre and Post-test Scores

	Pre-test Score	Post-test Score
N = 13		
1	60	60
2	49	48
3	52	53
4	50	59
5	45	60
6	47	53
7	57	50
8	47	54
9	61	60
10	56	55
11	41	50
12	41	62
13	54	54

Table 11

Descriptive Results for Pre-test and Post-test Scores

Measure	Pre-test Score	Post-test Score
N	13	13
Mean	50.77	55.23
Median	50.00	54.00
Std. Deviation	6.61	4.55

The desired number of participants for the pilot test was 40. The inability to recruit at other facilities outside of the school for pregnant and parenting adolescents, and having fewer numbers of adolescents who are pregnant attending at this time of the year, resulted in a smaller pool of potential participants for the study. Eighteen students

initially expressed interest, 13 enrolled, five were excluded for age (four were 14 years old and one was 20 years old), two were excluded for not having a cellular phone, and one was excluded for not being able to speak and read English. Additional recruitment efforts resulted in three potential participants that were excluded, one did not have a cellular phone, one was not able to speak and read English and one delivered the next day. All of the original 13 participants who enrolled completed the pilot study. Planning for 40 participants, the researcher chose the *t-test* for paired samples for analysis. The assumption of normal distribution was violated as shown in the histograms of pretest and posttest scores in Figures 4 and 5. The histograms both show a bi-modal distribution of the scores instead of the desired normal distribution.

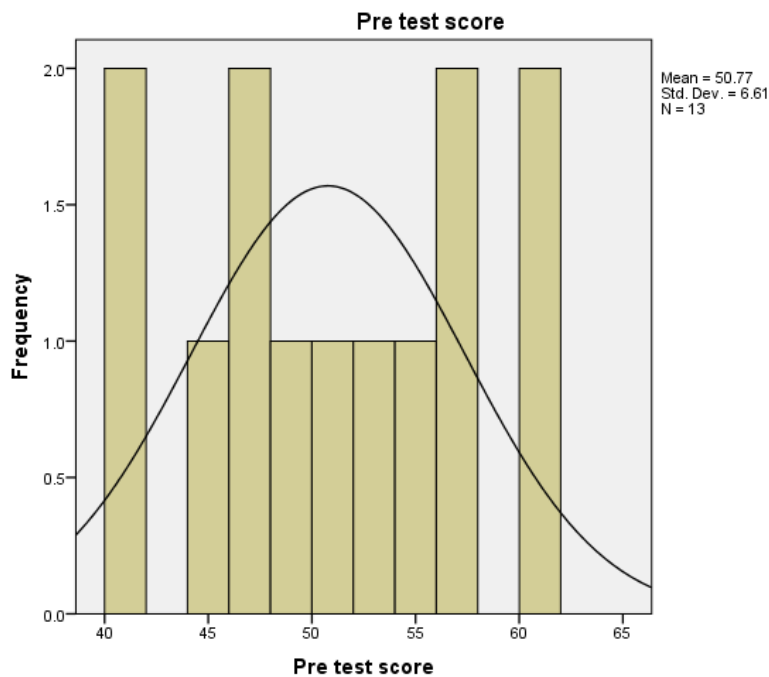


Figure 4. Pretest histogram

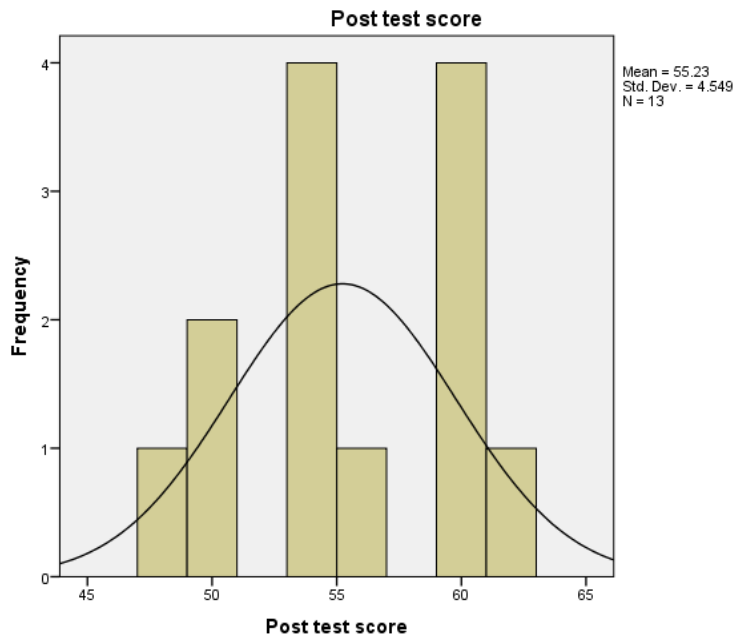


Figure 5. Posttest histogram

The paired *t*-test could not be utilized for analysis. Additionally the smaller sample size contributed to the elimination of this test. A non-parametric analysis was required and the Wilcoxon Signed Ranks test was chosen. Non-parametric tests are utilized in cases of small samples and distortions of the data (Munro, 2005). The Wilcoxon Signed Ranks test, comparable to the parametric paired *t* test, was utilized for analysis of the pretest-posttest scores. The Wilcoxon is utilized with repeated measures designs to identify the differences between scores, see Table 12. The statistical package for the social sciences (SPSS) data analysis software, version 19, was used for analysis.

Table 12

Results for Wilcoxon Signed Ranks Test

Measure	Pre-test Score - Post-test Score
Z	-1.69
P (2-tailed)	.089
$p = .05$	

Summary of the Findings

The evaluation of the educational text messages by the professional SMEs and focus groups resulted in establishing content validity. The focus group transcripts were evaluated for common themes and acceptance of the message content was stated by the focus groups, with requests for examples on five messages and clarification of one word in one message. The Wilcoxon signed ranks test results were similar results, $Z = -1.69$, $p = .089$. The interpretation of these results will provide guidance for the researcher to draw conclusions, if possible, and identify directions for further study.

CHAPTER V

SUMMARY OF THE STUDY

Adolescent pregnancy is a concern of health care providers worldwide. Pregnant adolescents tend to seek prenatal care after the first trimester, or not at all, miss prenatal appointments, have problems with weight gaining during pregnancy, and deliver low or high birth weight babies (CDC, 2000; CDC – Birth Weight, 2013; Harper et al., 2011; Ludwig & Currie, 2010; March of Dimes, 2011; Perron et al., 2010; Wilson et al., 2012). Concerns have arisen regarding whether pregnant women are receiving the education needed to eat healthy and be active during their pregnancy. Several studies have identified that some women state they know to eat healthy and exercise but do not specifically know what to eat or what kind of activity to perform or where to get the information (Collins & Champion, 2014; Hearn et al., 2014; Krans & Chang, 2012; Lucas et al., 2014; Reyes et al., 2013).

It is unclear if adolescents have knowledge about nutrition and physical activity to keep gestational weight gain within recommended IOM guidelines (Institute of Medicine, 2009; Lucas et al., 2014). This study aimed to develop a literature based educational text messaging intervention, utilize subject matter experts (SMEs) to assess the content validity of the intervention, and pilot test the intervention for effect on pregnant adolescents' knowledge of nutrition and physical activity.

The research questions that guided this study were: 1) What is the content validity of the researcher developed text messaging intervention and 2) How does an educational text message intervention influence pregnant adolescents' knowledge of nutrition and physical activity? Findings related to these research questions are discussed here.

Summary

Initially, the investigator developed literature based educational text messages covering nutrition and physical activity during pregnancy. The idea for development of this intervention evolved from over 30 years of experience working with and caring for pregnant women, pregnant adolescents in particular, and high-risk maternity patients in all aspects of the perinatal period. Observing pregnant adolescent eating behaviors and conversations related to healthy and unhealthy eating habits, in addition to observing a steady increase in the number of overweight or obese adolescents stimulated a concern in the investigator for these individuals and their infants. Additionally, over 25 years of experience teaching nursing students in the perinatal areas also instilled the desire to provide an educational message about nutrition and physical activity to pregnant adolescents. The combined experience of working with pregnant women and adolescents, as well as teaching nursing students in perinatal areas caring for pregnant adolescents contributed to the development of the text messages. Selection of the text message content was determined from this professional experience with the population, established recommended guidelines, and supporting evidence found in the literature. Once the messages were developed, the reading level was adapted to the 6th grade reading

level based on the Flesch Kincaid readability tool. After IRB approval was obtained, potential participants were approached, the study was explained, and informed consent was obtained as required prior to beginning data collection.

Subject Matter Experts

To address the first research question, “What is the content validity of the researcher developed text messaging intervention”, the opinions of professional subject matter experts (SME) were sought. The professional SMEs initially evaluated each of the 29 educational text messages (hereafter referred to as items) for relevancy, sufficiency and clarity. A 4 point scale where 1= not relevant, sufficient, or clear, 2 = somewhat relevant, sufficient, or clear, 3 = relevant, sufficient, or clear, and 4 = extremely relevant, sufficient, or clear was used. According to Lawshe (1975), a mean content validity ratio (CVR) score across items may be used as an indicator of content validity. As greater numbers of SME’s agree an item is essential (relevant, sufficient, and clear), the item has stronger levels of content validity. The possible CVR range was -1 to + 1, with the positive numbers indicating validity. The equation was $CVR = n - (N/2) / N/2$; where n equaled the number of SMEs rating the item at essential or higher and N equaled the total number of SMEs completing the evaluation. The items were scored and the CVR evaluated for each item in each area of relevancy, sufficiency, and clarity. If any item scored lower than .33 it was deleted. Two items (15 & 16) were dropped for scores of less than .33 under the category of sufficiency. Additionally, two items (24 & 27) were combined and the wording of 11 items were clarified as suggested by two SMEs. The

items were adapted based on the suggestions. The resulting 26 items were sent back to the SMEs for review of correctness of intended changes. All SMEs agreed the content and intended changes were correct. The items were reviewed again by the SMEs following revisions based on feedback from the focus groups with continued agreement responses received regarding content.

Focus Groups with Subject Matter Experts

The second group of SMEs was comprised of pregnant and parenting adolescents representing the population who will ultimately use the intervention. This group was considered SMEs on adolescents and to what type of messages adolescents would listen and respond. Two focus groups were conducted with eight participants each for a total of 16 participants. The focus groups were conducted during the lunch hour at the school in a private area free from distractions. Both groups reviewed each of the 26 educational text message items for relevancy, clarity, and suitability for the population of pregnant adolescents.

Continuous analysis was utilized and adjustments were made in the questions and discussion from the first group to the second group (Krueger & Casey, 2009). Specific adjustments consisted of giving examples of various types of food and clarification of the term, psychosocial, which was changed to thoughts and emotions. The transcripts from each focus group were analyzed using the constant comparative method. The feedback from each focus group was evaluated for themes and the items revised as indicated. Consistently, the comments from both groups were that the items were good to know and

no additional information was needed for the population. Both groups indicated the items were written at a level that was understandable for the population of interest. The first group suggested adding examples for some of the foods such as green vegetables, fruit, and fish so they would know specifically what to eat. This applied to items 5, 7, 8, 9, and 10, with several participants repeatedly asking, “What are some examples?” and others commenting “I didn’t know I could eat fish!” During the second focus group, with examples given for the items, participants made comments such as, “Ok, I can eat that” or “Are there more examples?” A participant in the second focus group asked to have the word psychosocial defined. Feedback from both focus groups indicated that pregnant adolescents would be comfortable receiving these text messages. Comments on individual items included “Ok”, “I would listen to that”. The comment that best summarized the response to all of the items combined was, “They tell you stuff and aren’t preachy”. The professional SMEs reviewed and approved the revised items a final time before pilot testing began.

At the completion of this study, an educational texting intervention has been reviewed by two groups of SME’s (professionals and adolescents), and described as applicable and acceptable to the population. This intervention was deliverable in a relevant and inexpensive way to pregnant women, and adolescents in particular. Now, the intervention was ready to be tested in a pilot study.

Pilot Study

The second research question was: How does an educational text message intervention influence pregnant adolescents' knowledge of nutrition and physical activity? This question was partially addressed with a one group pre-test post-test pilot study. The educational intervention consisting of text messages sent twice a week for eight weeks is described here.

The pilot test sample for the education text message intervention consisted of 13 total participants. An ongoing attempt was made to add participants throughout the intervention with no new participants added. Each month potential students were screened for admission into the pregnant and adolescent school program. As each new pregnant adolescent student was enrolled in the school, the study was described individually by the researcher. A total of three new students were enrolled at the school and were excluded, one did not have a cellular phone, one was not able to speak and read English and one delivered the next day.

The pilot test of the text message intervention consisted of a pretest questionnaire, texting two messages a week for eight weeks followed by a posttest questionnaire. The messages were sent each Monday and Thursday at 4:00 p.m. for eight weeks. The FNPA was planned as the pretest posttest to measure participant knowledge of nutrition and physical activity before and after the educational intervention. In actuality, the tool was a behavioral based screening tool for risk of obesity and the researcher was not measuring knowledge, but behavior. The questions and total score of the instrument identified

behaviors of a favorable or unfavorable environment which increase or decrease risk of obesity. The alpha reliability was 0.72 for the instrument with two confusing questions removed and with the original 21 questions, the reliability was 0.70. Content validity was established and average construct validity was 0.24. Permission was obtained to use the instrument and to adapt the wording from the 'My family/My child' language to 'I' and use with the pregnant adolescent sample. The established reliability no longer applied to the instrument after adaptation of the language and with utilization of the instrument in a different population. The instrument was utilized as the pretest posttest assessment to identify if the posttest scores, behavior, changed after receiving the text message intervention.

The adapted FNPA tool consisted of 20 items, rated on a 4-point Likert-type scale. Each individual answered the statement according to the options identified: almost never, sometimes, usually, and almost always. The possible score of 20-80 was then calculated by adding a value of 1-4 from left to right for each item, except for items that are reverse coded (3, 4, 5, 7, and 13), which are added from 4-1 from left to right. The tool contained 10 factors with two questions capturing each factor for a total of 20 items. The instrument and the texting intervention aligned in part or all of eight of the 10 construct areas. The instrument constructs addressed were: (1) family meals, (2) food choices, (3) beverage choices, (4) restriction/reward, (5) healthy environment, (6) family activity, (7) child activity, and (8) sleep rest.

Higher scores indicate more favorable environment and behaviors thus a lower risk for being overweight or at risk of overweight. The pre and posttest were scored by adding the points, as described above, for the questions in groups of two which represent the constructs, then adding all of the 10 construct points together. With this additional breakdown of scores, specific areas of risk which had low scores can be targeted. All participants completed all 20 items in the pre-posttests, resulting in no missing data to be discussed. The pretest and posttest were administered at the school in a quiet area.

Statistical analysis, using the Statistical Analysis for Social Sciences, version 19, was completed after the posttest was administered. The planned analysis was to be a *t-test* for paired samples, with 40 participants. The assumption of normal distribution was violated as shown by the histograms of pretest and posttest scores. The histograms both show a bi-modal distribution of the scores instead of the desired normal distribution expected. The violation of the assumption for normal distribution required the *t-test* not be used. A non-parametric analysis was required and the Wilcoxon Signed Ranks test was chosen. Non-parametric tests are utilized in cases of small samples and distortions of the data (Munro, 2005). The Wilcoxon Signed Ranks test, comparable to the parametric paired *t* test, was utilized for analysis of the pretest-posttest scores. The Wilcoxon is utilized with repeated measures designs and matched subjects groups to identify the differences between scores, therefore it was utilized to evaluate differences between the pretest-posttest scores. The Wilcoxon yielded results of approaching significance, although not statistically significant, $Z = -1.699$, $p = .089$.

Discussion of the Findings

The findings are discussed in order of the research progression, beginning with the SMEs, professional and adolescent focus groups, then the pilot study. The professional and adolescent focus group SMEs established content validity of the text message tool through their rankings and agreement. Additionally, a CVR was obtained on each of the original 29 items, resulting in a total of 26 items after the elimination of two items with low CVR scores and the combination of two items as suggested by the SMEs. The remaining items had a CVR score of .33 or higher indicating content validity of the item.

Consistent with the existing literature, comments from the focus groups indicated the pregnant adolescents were willing and receptive to receive the educational messages. The statements made by the focus groups in this educational texting intervention study indicate the items contained useful information for this population such as, “Ok, I can eat that”, and “I would listen to that”. The comment that best summarized the response to all of the items combined was, “They tell you stuff and aren’t preachy”. Hingle, Nichter, Medeiros, and Grace (2013) studied the use of text messages for weight control with diet and exercise support. Although the adolescents were not pregnant, the authors found the adolescents liked receiving healthy lifestyle messages. Another study using text messages with adolescents by Woolford et al. (2013) found the participants would welcome text messages regarding behavior change suggestions or support.

Hearn et al. (2014) found perinatal women desired information regarding “nutrition and diet, exercise ... realistic exercise they could do...quick, cheap, safe recipes they could easily prepare” (Hearn et al., 2014, p. 3). Further they identified the “need to recommend simple, inexpensive foods and activities” (p. 3). This is consistent with comments made by the focus groups suggesting the added examples for foods such as, green vegetables, fruit, and fish so they would know specifically what to eat. Participants repeatedly asked, “What are some examples?”, and after examples were given for the items, participants commented, “Ok, I can eat that” or “Are there more examples?” From the focus group comments, pregnant adolescents showed interest in knowing specific nutrition information consistent with other perinatal women described in the literature.

Consistent with the findings of Reyes et al. (2013) that African American mothers expressed a misunderstanding of what defined ‘healthy’ foods; the participants in the focus groups of this study expressed a desire to clarify and get examples of healthy foods. One participant comment was “What are some examples?” in reference to vegetables, nuts, and foods high in protein and iron. Further, the focus group participants’ comments about having a job and getting exercise by walking a lot on the job were consistent with the findings of Krans and Chang (2012) who found African American mothers had “a broad definition of what types of activities constituted exercise” (p. 1183). During the focus groups review of the text messages, participants made comments about the messages which were similar to what was found in the literature prior to the study. The

messages and the information contained within add support to the need to provide this information to pregnant women and adolescents specifically.

Bandura's Social Cognitive Theory (SCT) (1986) was identified as a framework for the pilot study. SCT supports the belief that an individual can shift their perspective as he/she moves from thinking to acting. Social cognitive theory identifies a relationship among three factors that relate to how individuals acquire and maintain health-related behaviors: personal characteristics, environmental events (social and physical), and personal experiences (behavioral) (Bandura, 2004). The constant interaction between person, behavior, and environment involving the triadic reciprocal determinism is central to understanding how SCT functions. These reciprocal interactions between person, behavior, and environment are not necessarily equal in strength or simultaneous, and differ based on the individual.

In the pilot study, SCT was to have been actualized when reciprocal interactions occurred between person, behavior, and environment as described below. The first interaction occurs between personal factors (preferences, cognitive and affective, beliefs, actions) and behavioral factors (capability, actions, habits, having knowledge). In the study, this interface occurs when the pregnant adolescent with beliefs or actions about nutrition and physical activity during pregnancy identifies their capability or knowledge of nutrition and physical activity when answering the pretest questionnaire. The second interaction occurs between personal and environmental factors (physical and sociocultural events) which includes the beliefs and cognitive competencies modified by

social and environmental events. In the study, this interface was demonstrated as the personal factor, participants' preferences and beliefs, were modified or not by the environmental factor, support/educational text messages received. The third interaction occurs between environmental factors and behavioral factors where behavior determines and is then modified by the environment as well as the environment influences the behavior. In the study, this interface was influenced by the participants behavior (prior capability, actions, and knowledge of nutrition and physical activity) influencing their environment of receiving the supporting educational text messages and utilizing the information, then responding back into the environment by potentially changing their behavior resulting in a change in their posttest questionnaire scores. Overall, the interdependency of the factors would be shown as the participant received the messages, their environment changes and instigates a rethinking of personal values among the pregnant adolescents and helps to facilitate further the uptake of new behaviors. The possibility of an immediate change in score on the posttest questionnaire is one short term indicator of this interaction. A future plan would be to repeat this study with a larger group, possibly a longer time frame, and see if behavior changes in a lasting way, and possibly consider weight changes.

The assumptions for this study were:

1. Learning is an internal process that may or may not change behavior (Bandura, 1997).
2. Behavior is directed toward particular goals (Bandura, 1997).

3. There is a triangle of reciprocal causality among personal, behavioral, and environmental influences (Bandura, 1997).
4. A change in the pretest posttest score indicates increased knowledge.

The first assumption regarding learning which may or may not change behavior is still accurate. The third assumption was demonstrated in the pilot study with changes in the participant behaviors with higher and lower scores on the posttest. The interaction among personal factor (pregnant adolescent) with the environmental factor (text messages received) influencing the behavioral factor (posttest scores) was inconclusive. A review and focus on the alignment of the text message intervention with the items in the posttest questionnaire instrument is warranted for future studies. The fourth assumption's accuracy regarding a change in scores indicating increased knowledge was not supported. The posttest actually measured behavior not knowledge, although Bandura (2004) states "knowledge of health risks and benefits creates the precondition for change" (p. 144). Some of the posttest scores were higher, some were not. Further study with a larger sample is necessary to make a conclusion.

Interpretations

Subject Matter Expert Evaluation Tool

The subject matter expert tool evaluated each of the 29 educational text messages (hereafter referred to as items) for relevancy, sufficiency and clarity. The SMEs gave of score of 1-4 on each item in the categories of relevancy, sufficiency and clarity. The researcher then computed a content validity ratio (CVR) score for each item. If any item

scored lower than .33 it was deleted. Two items (15 & 16) were dropped for scores of less than .33 (both scores zero) under the category of sufficiency. Both of these items were quick recipes and did not focus on the specific nutrition information like the other items. Additionally, two items (24 & 27) were combined. These items were very similar in the recommendation of a specific type of physical activity and a seasonally specify activity. According to the professional and adolescent SME evaluations and the CVR scoring, the items were adapted, resulting in 26 items final items with established content validity. As greater numbers of SME's agree an item is essential (relevant, sufficient, and clear), the item has stronger levels of content validity (Lawshe, 1975). The possible CVR range was -1 to + 1, with the positive numbers indicating validity. The scoring of the items for relevancy resulted in 23 (79.3%) at +1, five (17.2%) at .66, and one (3.4%) at .33. Scoring for sufficiency resulted in 10 (34.4%) at +1, 15 (51.7%) at .66, and one (3.4%) at .33. Scoring for clarity resulted in 12 (41.3%) at +1, 12 (41.3%) at .66, and 5 (17.2%) at .33. All were above .33, with the majority of 45 (51.7%) at +1. This evaluation tool and scoring was effective in establishing content validity and a strong educational text messaging intervention prior to conducting the pilot study.

Family Nutrition and Physical Activity Pretest Posttest Score

The adapted FNPA instrument consisted of 20 items, rated by each participant according to the options: almost never, sometimes, usually, and almost always. The researcher calculated the score by adding a value of 1-4 from left to right for each item, except for items that were reverse coded (3, 4, 5, 7, and 13), which are added from 4-1

from left to right. The pre and posttest were scored by adding the points, as described above, for the questions in groups of two which represent the constructs, then adding all of the 10 construct points together. The instrument and the texting intervention aligned in part or all of eight of the 10 construct areas. The instrument constructs addressed were: (1) family meals, (2) food choices, (3) beverage choices, (4) restriction/reward, (5) healthy environment, (6) family activity, (7) child activity, and (8) sleep rest. Higher scores indicate more favorable environment and behaviors thus a lower risk for being overweight or at risk of overweight. All participants completed all 20 items in the pre-posttests, resulting in no missing data to be discussed.

The histograms of both the pretest and posttest showed a bi-modal distribution of the scores instead of the desired normal distribution expected. The violation of the assumption for normal distribution required the *t-test* not be used. The non-parametric Wilcoxon Signed Ranks test, comparable to the parametric paired *t* test, was utilized for analysis of the pretest-posttest scores. The Wilcoxon is utilized with repeated measures designs and matched subjects groups to identify the differences between scores, therefore it was utilized to evaluate differences between the pretest-posttest scores. A Z-score must be less than -1.96 or greater than 1.96 to reject a null hypothesis, and say there was a difference. The Wilcoxon yielded results trending toward or approaching significance, with $Z = -1.699$, $p = .089$. Although the results were not statistically significant, important discussion can be addressed.

The results could be due to having a small sample size, in which case the study needs to be repeated with an adequate sample of 40 and see how the results differ. The instrument may not have been sensitive to the texts that were utilized. The instrument and intervention did not align exactly and the behavioral language of the instrument differed from the informational language of the intervention. These differences may have led to the instrument not really measuring a change in the participants. The researcher intended to measure a change in knowledge, while, in fact the instrument measured if the environment and behaviors are favorable and have lower risk of obesity or unfavorable and have a higher risk of obesity. The researcher developed a strong text messaging intervention, and learned the pretest posttest results were encouraging, there was a change in behavior and this needs to be explored further. The researcher learned about the challenges getting a study with a protected sample through multiple IRB approvals and the impact the challenges and delays can have on the study. Starting this study during the second half of the school year yielded few potential participants than if the study had started in the first half of the school year. Additionally, recruiting from multiple sites would have been more ideal and would be a focus when this study is repeated in the future.

Conclusions and Implications

From the findings, the researcher is able to make conclusions about the study and suggest appropriate use of the outcomes. The purpose of this study was to develop an educational text message intervention, focusing on nutrition and physical activity in

pregnancy, for pregnant adolescents; validate the tool; and conduct a pilot study of the tool. Prior to the study, literature indicated teenagers were receptive to receiving text messages for health promotion; adolescents had a knowledge deficit about what foods are healthy; and pregnant women desired more information about nutrition and types of physical activity to undertake during pregnancy. After the study, evidence demonstrated the pregnant adolescents were also receptive to text messages for health promotion information and wanted more information/knowledge of healthy foods and physical activity during pregnancy. A strong text message instrument was developed and validated, based on the CVR. Although the statistical analysis after the pilot approached significance, data did not establish a significant difference regarding increased knowledge. Therefore, the conclusions from the study were:

1. The educational text message intervention has content validity established through the evaluation by the professional and adolescent SMEs and CVR.
2. The Wilcoxon results were trending toward significance. The assumption of normal distribution was not met and results were not statistically significant.
3. The study's small sample size influenced the results and no claims or generalizations can be stated.

From these conclusions, implications are discussed. The implications are:

1. This study needs to be repeated with a larger sample of 40 or greater participants to test the text message interventions influence on knowledge.

2. The educational text messages provide the information desired by pregnant women and adolescents according to the literature and the pregnant adolescent SMEs.
3. The text message intervention could be utilized to supplement ongoing prenatal care, by providing additional information on nutrition and physical activity, as supported in the literature. Text messages were written in the style that was acceptable to the end users, pregnant adolescents.

Recommendations for Further Study

In summary, the study outcomes present great opportunities for further studies.

The recommendations for further study which evolved from this study include:

1. Repeat study with a larger sample of 40 or greater participants. The increased number of participants would potentially provide a stronger statistical analysis outcome in relation to the influence of the tool on pregnant adolescents' behavior.
2. The intervention time frame could be increased to ten weeks which would allow for more of the items to be sent to the participants and more fully test the tool. The increased time frame would allow two messages to be sent each week for ten weeks totaling 20 messages. After removing the six messages relating more to prenatal care, all of the messages would be tested.
3. After validation/testing of the education text message tool in a larger study, the study could be expanded to test influence on other pregnancy outcomes such as gestational weight gain and or fetal birth weight. These are outcomes believed to

be influenced by the nutritional intake and physical activity of the pregnant woman.

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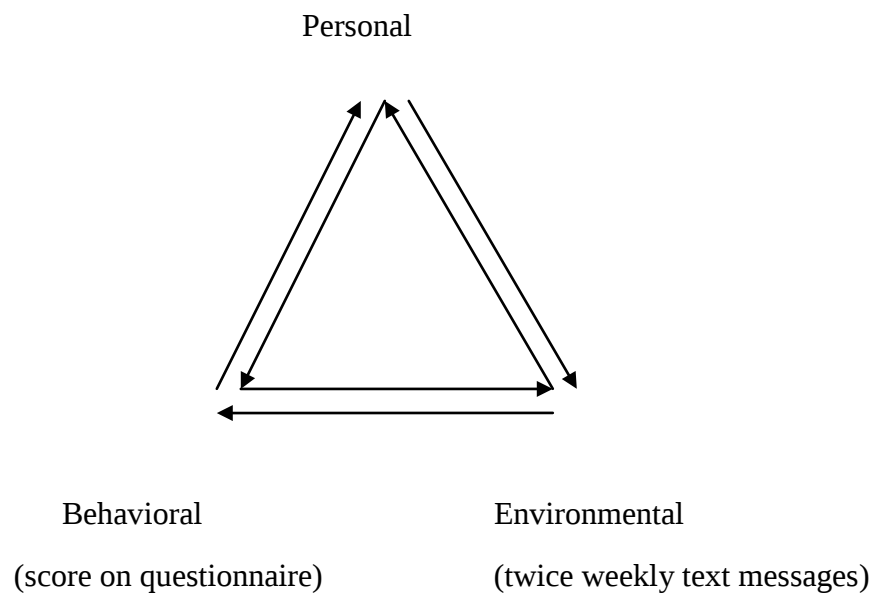
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APPENDIX A

Social Cognitive Theory Model

Figure 1. Social Cognitive Theory Model



APPENDIX B

Original Educational Text Messages with Literature Support

Original Educational Text Messages with Literature Support

1. Eating at least 5 servings of fruits and vegetables a day will help you feel full. (Barger, 2010; IOM, 2009; United States Department of Agriculture [USDA - MyPlate], 2011)
2. Eating 3 meals plus 2 snacks a day is recommended to help meet the nutritional needs of you and your baby. (Barger, 2010; IOM, 2009)
3. Drinking 8 to 10 cups of water a day helps your body utilize vitamins, control body temperature, and feel better! (AND, 2014)
4. It is important to your baby's health to limit caffeine to 2 cups of coffee a day, or 4 cups of tea and drink water and juice instead. Avoid all colas and energy drinks! (ACOG, 2006; Widen & Siega-Riz, 2010)
5. Eating green vegetables, fruits, and grains (wheat, rye, barley, and brown rice) stabilizes blood glucose and decreases constipation. (ACOG, 2006; USDA, 2011)
6. Chicken and fish are excellent sources of lean protein which helps your baby's body develop, especially the brain. (ACOG, 2006; USDA, 2011)
7. Eating dark leafy greens, spinach, and dairy supplies calcium for your baby's heart, nervous system, and bones! (ACOG, 2006; Barger, 2010; IOM, 2009; USDA, 2011)
8. Eating Omega 3 (found in fish) 2 times a week helps your skin, eyes and heart stay healthy. (ACOG, 2006; Barger, 2010; IOM, 2009)
9. Fruits, vegetables, grains, and lean protein are loaded with nutrients for you and your baby. (ACOG, 2006; Barger, 2010; Widen & Siega-Riz, 2010)
10. Get plenty of Iron by eating meat, poultry, eggs, and dark leafy greens to give your baby oxygen and a healthy birth weight. (ACOG, 2006; Barger, 2010; IOM, 2009; Widen & Siega-Riz, 2010)
11. Decreasing high calorie, high fat, and sugary foods gives you more energy and fewer cravings throughout the day. (Barger, 2010)
12. Take your prenatal vitamins which contain folic acid to help decrease some birth defects. (ACOG, 2006; Barger, 2010)
13. Eating fruit with each meal is an easy way to get dessert and meet the goal of 5 fruits or vegetables a day! (ACOG, 2006; Barger, 2010; IOM, 2009; USDA, 2011)
14. Your favorite raw vegetables cut and dipped in yogurt or hummus is a healthy way to beat the snack attack!
15. For a yummy way to help meet your fruit and dairy needs, try a filling Tropical Energy Smoothie blend 1 banana, 1 cup low fat plain yogurt, 1 1/2 cup pineapple juice, and flesh of 1 medium papaya!

16. Mix one 15 oz. can of pumpkin and 1 box yellow cake mix, bake in muffin tins at 350 for 19-23 minutes for a healthy Pumpkin Muffin snack.
17. Get your daily fruit needs early in the day by mixing 1 chopped apple, 1/2 cup raisins, 1 cup grapes, 2 sliced bananas, 1 cup berries, and 2 cups vanilla low fat yogurt for breakfast, snack or dessert.
18. Attending your prenatal appointment for regular monitoring helps your baby arrive healthy. (ACOG, 2006)
19. Tracking your weight gain during pregnancy is easy at your prenatal appointment. (ACOG, 2006)
20. See the results of your exercise and healthy eating at your next prenatal appointment. (ACOG, 2006)
21. Prenatal care is important for monitoring your baby's and your health. (ACOG, 2006)
22. Keeping your prenatal appointment lets you keep track of your baby's growth and talk to you doctor about anything! (ACOG, 2006)
23. Monitoring your blood pressure, lab work, baby's growth and risk of complications all happens at your prenatal appointment. (ACOG, 2006)
24. Exercising 30 minutes a day 5 days a week is recommended. Going for a swim is one way to exercise, cool off, and get some exercise! (ACOG, 2006; Juhl, 2010; Prather, 2012; Ruchat et al., 2012)
25. Sleeping 8 to 10 hours a night will give you more energy to get through the day. (ACOG, 2006)
26. Regular exercise is important in controlling weight gain during pregnancy and helps you be prepared for labor by getting stronger. (Juhl, 2010; Ruchat et al., 2012)
27. Walking is an easy exercise – for 30 minutes or 10 minutes 3 times a day! (ACOG, 2006; Prather, 2012; Ruchat et al., 2012)
28. Exercise is linked to improved psychosocial well-being, decreased anxiety and depression during pregnancy. (Prather, 2012)
29. Potentially improved neurodevelopment in children has been linked to women who exercise when pregnant. (Prather, 2012)

APPENDIX C

Adapted Family Nutrition and Physical Activity (FNPA) tool

Family Nutrition & Physical Activity	FOR EACH QUESTION, PLEASE SELECT THE ANSWER THAT BEST REPRESENTS YOUR CHILD/FAMILY
--------------------------------------	--

FOR EACH QUESTION, PLEASE SELECT THE ANSWER THAT BEST REPRESENTS YOUR CHILD/FAMILY

	Almost Never	Some- times	Usually	Almost Always
1. I eat breakfast....				
2. My family eats meals together.....				
3. I eat while watching TV ...				
4. I eat fast food....				
5. I use microwave or ready to eat foods ...				
6. I eat fruits and vegetables at meals or snacks...				
7. I drink soda pop or sugar drinks...				
8. I drink low fat milk at meals or snacks...				
9. I monitor eating of chips, cookies, and candy...				
10. I use candy as a reward for good behavior...				
11. I spend less than 2 hours on TV/games/computer per day				
12. My family limits the amount of TV I watch...				
13. I watch TV in my bedroom...				
14. My family provides opportunities for physical activity				
15. My family encourages me to be active every day				
16. My family finds ways to be physically active together ...				
17. I do physical activity during my free time...				
18. I am enrolled in sports or activities with a coach or leader...				
19. I have a daily routine for my bedtime...				
20. I get 9 hours of sleep a night ...				

Scoring: Add up scores for each scale (items should be scored 1,2,3,4 from left to right except for items that are reverse coded (3,4,5,7,10, and 13). These should be scored 4,3,2,1 from left to right. See back for feedback

Family Meal Patterns	Item 1	_____	+	Item 2	_____	=	_____
Family Eating Habits	Item 3	_____	+	Item 4	_____	=	_____
Food Choices	Item 5	_____	+	Item 6	_____	=	_____
Beverage Choices	Item 7	_____	+	Item 8	_____	=	_____
Restriction / Reward	Item 9	_____	+	Item 10	_____	=	_____
Screen time behavior and monitoring	Item 11	_____	+	Item 12	_____	=	_____
Healthy Environment	Item 13	_____	+	Item 14	_____	=	_____
Family Activity Involvement	Item 15	_____	+	Item 16	_____	=	_____
Child Activity Involvement	Item 17	_____	+	Item 18	_____	=	_____
Family Routine	Item 19	_____	+	Item 20	_____	=	_____
Total Score							_____

The FNPA Tool was developed at Iowa State University by Michelle Ihmels (mihmels@iastate.edu) and Greg Welk (gwelk@iastate.edu) in partnership with the American Dietetics Association. Adapted with permission.

APPENDIX D
Demographic Form

Site: School Program BA _____ Identification Number _____

School Program Tulsa _____

Mobile phone number (10 digits) _____

Back up phone number (10 digits) _____

Age: _____ EDC (due date): _____

Pregnant (gravida): 1st _____ 2nd _____ 3rd _____

Baby (para): 1st _____ 2nd _____ 3rd _____

Married: _____ Single _____ Divorced _____

Ethnic Group: Caucasian _____

Hispanic _____

African American _____

American Indian _____

Asian _____ specify _____

European _____

Other: specify _____

English as a second language: Yes _____ No _____

Last grade completed: _____

Living arrangements (who you are living with and age, if known)

Are you currently living with:

Mother _____ Age _____

Father _____ Age _____

Both Parents _____ Age _____

Alone _____ Age _____

Significant Other _____ Age _____

Husband _____ Age _____

Other: specify _____ Age _____

APPENDIX E

Text Message Intervention (Final Version)

TEXT MESSAGE INTERVENTION

Text Message	Order sent
1. Eating at least 5 servings of fruits and vegetables a day will help you feel full.	#1
2. Eating 3 meals plus 2 healthy snacks a day is recommended to help meet the nutritional needs of you and your Baby.	Omit
3. Drinking 8 to 10 cups of water a day helps your body utilize vitamins, control body temperature, and feel better!	#2
4. It is important to your baby's health to limit caffeine to 2 cups of coffee or 4 cups of tea a day, and drink water instead. Avoid all colas and energy drinks!	Omit
5. Eating green vegetables (broccoli, spinach), fruits (apples, berries, pears), and grains (like whole grain crackers and bread) stabilizes blood glucose and decreases constipation.	#3
6. Chicken and fish are excellent sources of lean protein which helps your baby's brain and body develop without extra calories.	#5
7. Eating dark leafy greens (kale, collards, turnip greens, spinach, & broccoli) and dairy supplies calcium for your baby's heart, nervous system, and bones!	#7
8. Eating Omega 3 fats - found in fish (salmon, tilapia, sardines, catfish) and some nuts (almonds, cashews, walnuts, pecans, pistachios) 2 times a week helps your skin, eyes and heart stay healthy.	#6
9. Fruits, vegetables, grains, and lean protein are loaded with nutrients for you and your baby.	#16
10. Get plenty of Iron by eating meat (lean beef, liver, pork), poultry (chicken, turkey), eggs, and dark leafy greens (broccoli, spinach, brussell sprouts, collard & turnip greens) to give your baby oxygen and a healthy birth weight.	#9
11. Decreasing high calorie, high fat, and sugary foods gives you more energy and fewer cravings throughout the day.	#14
12. Take your prenatal vitamins which contain folic acid to help decrease some birth defects.	#11
13. Eating fruit with each meal is an easy way to get dessert and meet the goal of 5 fruits or vegetables a day!	#10
14. Your favorite raw vegetables cut and dipped in yogurt or hummus is a healthy way to beat the snack attack!	#13
15. Get your daily fruit needs early in the day by mixing 1 chopped apple, 1/2 cup raisins, 1 cup grapes, 2 sliced bananas, 1 cup berries, and 2 cups	Omit

vanilla Greek yogurt for breakfast, snack or dessert.	
16. Attending your prenatal appointment for regular monitoring helps your baby arrive healthy.	Omit
17. Tracking your weight gain during pregnancy is easy at your prenatal appointment.	Omit
18. See the results of your exercise and healthy eating at your next prenatal appointment.	Omit
19. Prenatal care is important for monitoring your baby's and your health.	Omit
20. Keeping your prenatal appointment lets you keep track of your baby's growth and talk to you doctor about anything!	Omit
21. Monitoring your blood pressure, lab work, risk of complications and baby's growth all happens at your prenatal appointment.	Omit
22. Exercising 30 minutes a day 5 days a week is recommended. Walking is an easy exercise – do it for 30 minutes or 10 minutes 3 times a day!	#4
23. Have more energy to get through the day by sleeping 8 to 10 hours a night.	#15
24. Regular exercise is important in controlling weight gain during pregnancy and helps you be prepared for labor by getting stronger.	#12
25. Exercise is linked to improved thoughts and emotions, and decreased anxiety and depression during pregnancy.	omit
26. Potentially improved healthy brain development in children has been linked to women who exercise when pregnant.	#8

APPENDIX F
Subject Matter Expert Rating Form

SUBJECT MATTER EXPERT TEXT MESSAGE RATING SCALE

Please review the text messages provided. After each text message please check the box that you think best fits the text message, using the scale provided.

For each text message, please rate for relevancy, sufficiency, and clarity on a numerical scale of 1-4:

Definition of Relevancy: Is the text message relevant to the concept of prenatal nutrition or physical activity?

Definition of Sufficiency: Is the text message sufficient to the concept of prenatal nutrition or physical activity?

Definition of Clarity: Does the text message clearly identify the concept of prenatal nutrition or physical activity?

TEXT MESSAGE	Relevancy 1= not relevant 2= somewhat relevant 3= relevant 4= extremely relevant	Sufficiency 1= not sufficient 2= somewhat sufficient 3= sufficient 4= extremely sufficient	Clarity 1= not clear 2= somewhat clear 3= clear 4= extremely clear
1. Eating at least 5 servings of fruits and vegetables a day will help you feel full.			
2. Eating 3 meals plus 2 snacks a day is recommended to help meet the nutritional needs of you and your Baby.			
3. Drinking 8 to 10 cups of water a day helps your body utilize vitamins, control body temperature, and feel better!			
4. It is important to your baby's health to limit caffeine to 2 cups of coffee a day, or 4 cups of tea and drink water and juice instead. Avoid all colas and energy drinks!			
5. Eating green vegetables, fruits, and grains (wheat, rye, barley, and brown rice) stabilizes blood glucose and decreases constipation.			

6. Chicken and fish are excellent sources of lean protein which helps your baby's body develop, especially the brain.			
7. Eating dark leafy greens, spinach, and dairy supplies calcium for your baby's heart, nervous system, and bones!			
8. Eating Omega 3 (found in fish) 2 times a week helps your skin, eyes and heart stay healthy.			
9. Fruits, vegetables, grains, and lean protein are loaded with nutrients for you and your baby.			
10. Get plenty of Iron by eating meat, poultry, eggs, and dark leafy greens to give your baby oxygen and a healthy birth weight.			
11. Decreasing high calorie, high fat, and sugary foods gives you more energy and fewer cravings throughout the day.			
12. Take your prenatal vitamins which contain folic acid to help decrease some birth defects.			
13. Eating fruit with each meal is an easy way to get dessert and meet the goal of 5 fruits or vegetables a day!			
14. Your favorite raw vegetables cut and dipped in yogurt or hummus is a healthy way to beat the snack attack!			
15. For a yummy way to help meet your fruit and dairy needs, try a filling Tropical			

Energy Smoothie. Blend 1 banana, 1 cup low fat plain yogurt, 1 1/2 cup pineapple juice, and flesh of 1 papaya!			
16. Mix one 15 oz. can of pumpkin and 1 box yellow cake mix, bake in muffin tins at 350 for 19-23 minutes for a healthy Pumpkin Muffin snack.			
17. Get your daily fruit needs early in the day by mixing 1 chopped apple, 1/2 cup raisins, 1 cup grapes, 2 sliced bananas, 1 cup berries, and 2 cups vanilla low fat yogurt for breakfast, snack or dessert.			
18. Attending your prenatal appointment for regular monitoring helps your baby arrive healthy.			
19. Tracking your weight gain during pregnancy is easy at your prenatal appointment.			
20. See the results of your exercise and healthy eating at your next prenatal appointment.			
21. Prenatal care is important for monitoring your baby's and your health.			
22. Keeping your prenatal appointment lets you keep track of your baby's growth and talk to you doctor about anything!			
23. Monitoring your blood pressure, lab work, baby's growth and risk of complications all happens at your prenatal appointment.			

24. Exercising 30 minutes a day 5 days a week is recommended. Going for a swim is one way to exercise, cool off, and get some exercise!			
25. Sleeping 8 to 10 hours a night will give you more energy to get through the day.			
26. Regular exercise is important in controlling weight gain during pregnancy and helps you be prepared for labor by getting stronger.			
27. Walking is an easy exercise – for 30 minutes or 10 minutes 3 times a day!			
28. Exercise is linked to improved psychosocial well-being, decreased anxiety and depression during pregnancy.			
29. Potentially improved neurodevelopment in children has been linked to women who exercise when pregnant.			

APPENDIX G

Informed Consents:
Focus Group and Pilot Study

IFC TEXTING INTERVENTION TESTING:
TEXAS WOMAN'S UNIVERSITY
CONSENT TO PARTICIPATE IN RESEARCH

Title: Development and testing of a text messaging educational intervention for pregnant adolescents

Investigator: Rhonda R. Martin.....rmartin@twu.edu 918- -
Advisor: Donna Scott-Tilley, PhD.....DTilley@twu.edu 940-898-2437

Explanation and Purpose of the Research

You are being asked to participate in a research study for Ms. Martin's dissertation at Texas Woman's University. The purpose of this research is to develop and test a text messaging educational intervention for pregnant adolescents. You have been asked to participate in this study because you are a female age 16-19 years who is pregnant or parenting.

Description of Procedures

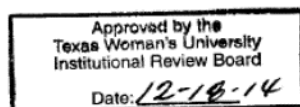
As a participant in this study you will be asked for your cellular telephone number. All the pregnant adolescents will receive twice weekly text messages. The text message will consist of educational information about nutrition, and physical activity appropriate during pregnancy. The weekly text messages will continue from enrollment in the study for 8 weeks.

It will take about 30 minutes to complete the informed consent process and a demographic form about your age, number of live births, number of pregnancies, estimated due date for this pregnancy, ethnic group, marital status, English as second language, grade completed, and 10 digit cellular telephone number, to be completed by all participants, prior to beginning the study. There will be a 20 item nutrition and physical activity screening tool to be completed as a pretest before receiving the text messages and again as a posttest after receiving the text messages. The estimated time commitment is approximately 30 minutes for each test. Reading the short text messages twice a week for 8 weeks will take about 30 minutes. The total time commitment is approximately 2 hours.

To participate, you must speak and read English, be 16-19 years of age, be pregnant at the beginning of the study, and own a cellular telephone capable of receiving text messages.

Potential Risks

Participation in this study may involve three risks, beyond those present in routine daily life. The potential loss of confidentiality, anonymity, and coercion is anticipated in this study. Completing the demographic questionnaire and the recording of the focus group may cause you to feel a loss of confidentiality. There is a potential risk of loss of confidentiality in all email, downloading, and internet transactions. Loss of confidentiality will be controlled by using only the assigned number on all materials and storing all materials where a security code is required for access. The presentation of the data will be anonymous to prevent the adolescent feeling a loss of anonymity. Being asked to participate in the study may make you feel coerced. Your participation is voluntary and if you choose to withdraw from the study at any time there will be no penalties.



Initials

Page 1 of 2

Participation and Benefits

Your involvement in this study is completely voluntary and you may withdraw at any time. A benefit to the participant is the knowledge gained from the text messages. There are no direct benefits from participating in this study.

Questions Regarding the Study

You will be given a copy of this signed and dated form to keep. If you have any questions about the research study you should ask the researchers; their phone numbers are at the top of the form. If you have questions about your rights as a participant in this research or the way it has been conducted, you may contact the Texas Woman's University Office of Research and Sponsored Programs at 940-898-3378 or via e-mail at IRB@twu.edu.

Signature of Participant

Date

Signature of Parent (if applicable)

Date

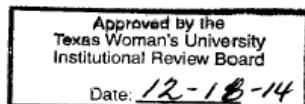
Parents please be aware that under the Protection of Pupil Rights Act 20 U.S.C. Section 1232© (1) (A), you have the right to review a copy of the questions asked of or materials that will be used with your students. If you would like to do so, you should contact Rhonda R. Martin at (918) . . . to obtain a copy of the questions or materials.

*If you would like to know the results of this study tell us where you want them to be sent.

Email: _____

Or

Address: _____



IFC FOR FOCUS GROUPS:

TEXAS WOMAN'S UNIVERSITY
CONSENT TO PARTICIPATE IN RESEARCH

Title: Development and testing of a text messaging educational intervention for pregnant adolescents

Investigator: Rhonda R. Martin.....rmartin@twu.edu 918-
Advisor: Donna Scott-Tilley, PhD.....DTilley@twu.edu 940-893-2437

Explanation and Purpose of the Research

You are being asked to participate in a research study for Ms. Martin's dissertation at Texas Woman's University. The purpose of this research is to develop and test a text messaging educational intervention for pregnant adolescents. You have been asked to participate in this study because you are a female age 16-19 years who is pregnant or parenting.

Description of Procedures

As a participant in this study you will be asked to participate in one of two focus groups consisting of 8-10 pregnant or parenting adolescents. The focus groups will be asked to review the text messages and provide comments on what should be changed or how the messages could better suit the adolescent population. The focus groups will last approximately one hour and will be audio recorded.

It will take about 30 minutes to complete the informed consent process and a demographic form about your age, number of live births, number of pregnancies, estimated due date for this pregnancy, ethnic group, marital status, English as second language, grade completed, and 10 digit cellular telephone number, to be completed by all participants, prior to beginning the study. The estimated time utilized to complete the focus group will be a maximum of approximately 60 minutes. Total time commitment is approximately 90 minutes.

To participate, you must speak and read English, be 16-19 years of age, and be pregnant or parenting for four months or less.

Potential Risks

Participation in this study may involve three risks, beyond those present in routine daily life. The potential loss of confidentiality, anonymity, and coercion is anticipated in this study. Completing the demographic questionnaire and the recording of the focus group may cause you to feel a loss of confidentiality. There is a potential risk of loss of confidentiality in all email, downloading, and internet transactions. Loss of confidentiality will be controlled by using only the assigned number on all materials and storing all materials where a security code is required for access. The presentation of the data will be anonymous to prevent the adolescent feeling a loss of anonymity. Being asked to participate in the study may make you feel coerced. Your participation is voluntary and if you choose to withdraw from the study at any time there will be no penalties.

Approved by the
Texas Woman's University
Institutional Review Board

Date: 12-18-14

Initials

Page 1 of 2

Participation and Benefits

Your involvement in this study is completely voluntary and you may withdraw at any time. A benefit to the participant is the knowledge gained from the text messages. There are no direct benefits from participating in this study.

Questions Regarding the Study

You will be given a copy of this signed and dated form to keep. If you have any questions about the research study you should ask the researchers; their phone numbers are at the top of the form. If you have questions about your rights as a participant in this research or the way it has been conducted, you may contact the Texas Woman's University Office of Research and Sponsored Programs at 940-898-3378 or via e-mail at IRB@twu.edu.

Signature of Participant

Date

Signature of Parent (if applicable)

Date

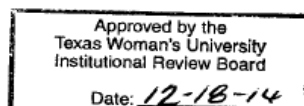
Parents please be aware that under the Protection of Pupil Rights Act 20 U.S.C. Section 1232© (1) (A), you have the right to review a copy of the questions asked of or materials that will be used with your students. If you would like to do so, you should contact Rhonda R. Martin at (918) 444-1111 to obtain a copy of the questions or materials.

*If you would like to know the results of this study tell us where you want them to be sent.

Email: _____

Or

Address: _____



APPENDIX H

Permission to Use Family Nutrition And Physical Activity Tool

To: Martin, Rhonda

From: Peyer, Karissa

Wednesday, October 15, 2014 5:54 PM

Re: permission to use the FNPA tool (used with adolescents, in pregnancy?)

karissapeyer@gmail.com on behalf of Karissa Peyer [kpeyer@iastate.edu]

Rhonda-

We are in the process of some updates to the FNPA following cognitive interviews. We are doing a reliability-comparison study of two different versions and hope to have those results by the end of the year. I will then be using the updated survey in a new cohort of 1st-grade parents and a follow-up with the original validation cohort who is now in 9th grade. I do want to put you in touch with a colleague of mine, Kimbo Yee at Michigan Statue who is going to be evaluating the FNPA in an adolescent cohort for his dissertation. I have already let him know that I would be directing you to him.

His email address is yeekimbo@msu.edu

Let me know if you have any other questions. We're excited that you are interested in the tool!

Karissa [Peyer]

kpeyer@iastate.edu

APPENDIX I

Original Family Nutrition And Physical Activity Tool (FNPA)

FOR EACH QUESTION, PLEASE SELECT THE ANSWER THAT BEST REPRESENTS YOUR CHILD/FAMILY

	Almost Never	Some- times	Usually	Almost Always
1. My child eats breakfast....	☐	☐	☐	☐
2. Our family eats meals together.....	☐	☐	☐	☐
3. Our family eats while watching TV ...	☐	☐	☐	☐
4. Our family eats fast food....	☐	☐	☐	☐
5. Our family uses microwave or ready to eat foods ...	☐	☐	☐	☐
6. My child eats fruits and vegetables at meals or snacks...	☐	☐	☐	☐
7. My child drinks soda pop or sugar drinks...	☐	☐	☐	☐
8. My child drinks low fat milk at meals or snacks...	☐	☐	☐	☐
9. Our family limits eating of chips, cookies, and candy...	☐	☐	☐	☐
10. Our family uses candy as a reward for good behavior...	☐	☐	☐	☐
11. My child spends less than 2 hours on TV/games/computer per day	☐	☐	☐	☐
12. Our family limits the amount of TV our child watches...	☐	☐	☐	☐
13. Our family allows our child to watch TV in their bedroom...	☐	☐	☐	☐
14. Our family provides opportunities for physical activity	☐	☐	☐	☐
15. Our family encourages our child to be active every day	☐	☐	☐	☐
16. Our family finds ways to be physically active together ...	☐	☐	☐	☐
17. My child does physical activity during his/her free time...	☐	☐	☐	☐
18. My child is enrolled in sports or activities with a coach or leader...	☐	☐	☐	☐
19. Our family has a daily routine for our child's bedtime...	☐	☐	☐	☐
20. My child gets 9 hours of sleep a night ...	☐	☐	☐	☐

Scoring: Add up scores for each scale (items should be scored 1,2,3,4 from left to right except for items that are reverse coded (3,4,5,7,10, and 13), These should be scored 4,3,2,1 from left to right. See Back for Feedback.

Family Meal Patterns	Item 1	_____	+	Item 2	_____	=	_____
Family Eating Habits	Item 3	_____	+	Item 4	_____	=	_____
Food Choices	Item 5	_____	+	Item 6	_____	=	_____
Beverage Choices	Item 7	_____	+	Item 8	_____	=	_____
Restriction / Reward	Item 9	_____	+	Item 10	_____	=	_____
Screen time behavior and monitoring	Item 11	_____	+	Item 12	_____	=	_____
Healthy Environment	Item 13	_____	+	Item 14	_____	=	_____
Family Activity Involvement	Item 15	_____	+	Item 16	_____	=	_____
Child Activity Involvement	Item 17	_____	+	Item 18	_____	=	_____
Family Routine	Item 19	_____	+	Item 20	_____	=	_____
						Total Score	_____

APPENDIX J

Focus Group Text Message Items

Focus Group Text Message Items

Please look over the messages below to determine if they are relevant in content, clear to understand and relevant to the pregnant adolescents. Thank you.

1. Eating at least 5 servings of fruits and vegetables a day will help you feel full.
2. Eating 3 meals plus 2 healthy snacks a day is recommended to help meet the nutritional needs of you and your baby.
3. Drinking 8 to 10 cups of water a day helps your body utilize vitamins, control body temperature, and feel better!
4. It is important to your baby's health to limit caffeine to 2 cups of coffee or 4 cups of tea a day, and drink water instead. Avoid all colas and energy drinks!
5. Eating green vegetables, fruits, and grains (like whole grain crackers and bread) stabilizes blood glucose and decreases constipation.
6. Chicken and fish are excellent sources of lean protein which helps your baby's brain and body develop without extra calories.
7. Eating dark leafy greens and dairy supplies calcium for your baby's heart, nervous system, and bones!
8. Eating Omega 3 fats (found in fish and some nuts) 2 times a week helps your skin, eyes and heart stay healthy.
9. Fruits, vegetables, grains, and lean protein are loaded with nutrients for you and your baby.
10. Get plenty of Iron by eating meat, poultry, eggs, and dark leafy greens to give your baby oxygen and a healthy birth weight.
11. Decreasing high calorie, high fat, and sugary foods gives you more energy and fewer cravings throughout the day.
12. Take your prenatal vitamins which contain folic acid to help decrease some birth defects.
13. Eating fruit with each meal is an easy way to get dessert and meet the goal of 5 fruits or vegetables a day!
14. Your favorite raw vegetables cut and dipped in yogurt or hummus is a healthy way to beat the snack attack!

15. Get your daily fruit needs early in the day by mixing 1 chopped apple, 1/2 cup raisins, 1 cup grapes, 2 sliced bananas, 1 cup berries, and 2 cups vanilla Greek yogurt for breakfast, snack or dessert.
16. Attending your prenatal appointment for regular monitoring helps your baby arrive healthy.
17. Tracking your weight gain during pregnancy is easy at your prenatal appointment.
18. See the results of your exercise and healthy eating at your next prenatal appointment.
19. Prenatal care is important for monitoring your baby's and your health.
20. Keeping your prenatal appointment lets you keep track of your baby's growth and talk to you doctor about anything!
21. Monitoring your blood pressure, lab work, risk of complications and baby's growth all happens at your prenatal appointment.
22. Exercising 30 minutes a day 5 days a week is recommended. Walking is an easy exercise – do it for 30 minutes or 10 minutes 3 times a day!
23. Have more energy to get through the day by sleeping 8 to 10 hours a night.
24. Regular exercise is important in controlling weight gain during pregnancy and helps you be prepared for labor by getting stronger.
25. Exercise is linked to improved psychosocial well-being, decreased anxiety and depression during pregnancy.
26. Potentially improved healthy brain development in children has been linked to women who exercise when pregnant.

APPENDIX K

TWU IRB Approval Letter and Addendum Approval



Institutional Review Board
Office of Research and Sponsored Programs
P.O. Box 425619, Denton, TX 76204-5619
940-898-3378
email: IRB@twu.edu
<http://www.twu.edu/irb.html>

DATE: December 18, 2014

TO: Ms. Rhonda R. Martin
Nursing

FROM: Institutional Review Board - Denton

Re: Exemption for Development and Testing of a Text Messaging Educational Intervention for Pregnant Adolescents (Protocol #: 17966)

The above referenced study has been reviewed by the TWU Institutional Review Board (IRB) and was determined to be exempt from further review.

If applicable, agency approval letters must be submitted to the IRB upon receipt PRIOR to any data collection at that agency. Because a signed consent form is not required for exempt studies, the filing of signatures of participants with the TWU IRB is not necessary.

Although your protocol has been exempted from further IRB review and your protocol file has been closed, any modifications to this study must be submitted for review to the IRB using the Modification Request Form. Additionally, the IRB must be notified immediately of any adverse events or unanticipated problems. All forms are located on the IRB website. If you have any questions, please contact the TWU IRB.

cc. Dr. Anita Hufft, Nursing
Dr. Donna Scott Tilley, Nursing
Graduate School



Institutional Review Board
Office of Research and Sponsored Programs
P.O. Box 425619, Denton, TX 76204-5619
940-898-3378
email: IRB@twu.edu
<http://www.twu.edu/irb.html>

DATE: March 24, 2015

TO: Ms. Rhonda R. Martin
Nursing

FROM: Institutional Review Board - Denton

Re: *Notification of Approval for Modification for Development and Testing of a Text Messaging Educational Intervention for Pregnant Adolescents (Protocol #: 17966)*

The following modification(s) have been approved by the IRB:

1. Requested to collect additional information.

cc. Dr. Donna Scott Tilley, Nursing

APPENDIX L

Site Approvals

Broken Arrow Public Schools

Research Request

Use this form to request permission for approval to conduct research in Broken Arrow Public Schools

Name of Person Who will Conduct Research Rhonda R. Martin

Date(s) of Research January 9, 2015 through March 2015

School site(s) to be Involved Margaret Hudson Program

I understand the criteria and obligations required to do a research study in the Broken Arrow Public School system and have attached a detailed application as outlined in Broken Arrow Public Schools' Policy for Conducting Research and Evaluation in Broken Arrow Public Schools.

Signature of applicant Rhonda Martin Date of request 1/5/15

Research Approved ✓ Research Denied

Research Review Board Chairperson [Signature]

January 26, 2015

Rhonda R. Martin
3360 s. 61st West Avenue
Tulsa Oklahoma 74107

Dear Mrs. Martin,

The Tulsa Public Schools Research Review Board (RRB)) has received and reviewed your application to conduct research in Tulsa Public Schools. Your proposed research is : *The purpose of this study will be to develop an educational text messaging intervention, utilize subject matter(SMEs) to assess the content validity of the intervention, and pilot test the intervention for effect on pregnant adolescents' knowledge of nutrition and physical activity.*"

I have attached the documents directly related to this study for your information and review.

Please be advised that approval from the RRB does not mandated individual school participation, as this is at the discretion of each principal being requested to participate. The involvement of Margret Hudson School is at the discretion of the principal. Please present a copy of this letter to the principal when you meet with her to discuss your project. This research project may not be extended to our sites without the expressed written permission of our RRB.

The proposed project will demonstrate a tangible benefit to the District and we would welcome the opportunity to receive a copy of your complete findings in a PDF electronic format and a briefing at its conclusion. Your proposal and application does meet the requirements of TPS Board Policy 9102.

Your project is approved as of January 26, 20145 subject to the following conditions.

1. It is the discretion of the principal of each school to participate in this project.
2. The principal of each school shall determine the time and circumstances under which you are granted access to the building, staff and students
3. Written individual consent as disclosed in your RRB application, must be obtained prior to conducting any structured interviews, focus group(s) and/or observations.
4. Access to school and student records or files as a part of this study is not approved.
5. The project is approved for one calendar year from the approval date.
6. The RRB reserves the right to suspend approval of the project in accordance with the conditions of the established rules.

Please do not hesitate to contact me should you have questions about our approval and support of this valuable project.

Taylor L. Young, Ph.D.
Director of Program Management (PMO)
Accountability Department
Tulsa Public Schools
District Enrollment Center Room 113
2819 South New Haven
Tulsa, OK. 74114
T: 918-746-6309
youngta@tulsaschools.org
www.tulsaschools.org

