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Digital Object Identifier: <https://doi.org/10.13023/etd.2019.426>

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THE INTERACTIVE EFFECT OF A TEXT MESSAGE INTERVENTION
AND CONNECTIVITY AMONG RURAL ADOLESCENTS

THESIS

A thesis submitted in partial fulfillment of the
requirements for the degree of Master of Science in Nutrition and Food Systems
in the College of Agriculture, Food and Environment
at the University of Kentucky

By

Kara Coldiron

Lexington, Kentucky

Director: Dr. Alison Gustafson, Professor of Dietetics and Human Nutrition

Lexington, Kentucky

2019

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ABSTRACT OF THESIS

THE INTERACTIVE EFFECT OF A TEXT MESSAGE INTERVENTION AND CONNECTIVITY AMONG RURAL ADOLESCENTS

Social cohesion among peers profoundly influences decision making during adolescence. Despite this, the current research is very limited concerning the association of social cohesion and intimacy among rural adolescent peers with dietary intake and weight outcomes. This is problematic because social cohesion could be an unknown contributing factor in obesity among rural adolescents. The purpose of this study was to investigate how social cohesion and intimacy among rural adolescents in Kentucky and North Carolina affects the outcomes of a text message intervention aimed at improving fruit, vegetable, fast food and sugar sweetened beverage intake. Additionally, to determine if social cohesion is an independent contributing factor to dietary intakes and weight outcomes among rural adolescents. It was found that the intervention had no effect on fruit and vegetable consumption and purchases and sugar sweetened beverage calories. However, the intervention did have a modest effect on the amount of times fast food was consumed per week.

KEYWORDS: Rural Adolescents, Social Cohesion, Dietary Intakes, Text Message
Intervention

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10/24/2019

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Chapter One: Introduction

Despite copious time and resources directed at reducing elevated obesity rates among adolescents, many youth are still plagued by a disease that could haunt them into adulthood. Adolescent obesity is a multifactorial disease, and rural versus urban living is an important environmental disease determinant. Rural children are more likely to be obese than their urban counterparts (Probst, Barker, Enders, & Gardiner, 2016). This is likely the result of reduced access to healthy food and differences in physical activity patterns between adolescents living in rural versus urban areas (Probst et al., 2016; Liu et al., 2012). Rural environmental disease determinants are concerning for many states, such as Kentucky and North Carolina, with more than 70% rural counties (Davis, 2009; Knopf, 2018).

Problem Statement

Social cohesion, the willingness of members of a society to cooperate with each other in order to survive and prosper (Stanley, 2003), among peers profoundly influences decision making during adolescence. Adolescents are modeling and imitating behaviors of friends to gain social acceptance and avoid judgement (Wouters, Larsen, Kremers, Dagnelie, & Greenen, 2010; Perkins, Perkins, & Craig, 2018). The current research is very limited concerning the association of social cohesion and intimacy among rural adolescent peers with dietary intake and weight outcomes. This is problematic because social cohesion could be an unknown contributing factor to the public health concern of obesity among rural adolescents.

Purpose

The purpose of this study is to investigate how social cohesion and intimacy among rural adolescents in Kentucky and North Carolina affects the outcomes of a text

message intervention aimed at improving fruit, vegetable, fast food and sugar sweetened beverage intake. Additionally, a secondary aim is to determine if social cohesion is an independent contributing factor to dietary intakes and weight outcomes among rural adolescents.

Research Questions

1. Is there a positive association between social cohesion and improved dietary intake among those participating in an 8-week text message intervention featuring affective messages and weekly challenges versus the control group?
2. Within the intervention group, is social cohesion at the beginning of the study an independent predictor of improved dietary intake?

Research Hypotheses

1. There is a stronger positive association between social cohesion and improved dietary intakes among those participating in the 8-week text message intervention compared to those in the control group.
2. At the beginning of the study, participants in the intervention group with high levels of social cohesion will have greater improvements in dietary intakes compared to those in the intervention group with low levels of social cohesion.

Justifications

Many justifications for the high prevalence of obesity among rural adolescents have been explored. However, the rates of this preventable disease are still increasing. Results from this study can be used to determine if social cohesion during adolescence affects dietary intakes and weight outcomes. Confirmation of this theory could be capitalized on to inform future nutrition interventions for this population.

Chapter Two: Literature Review

Introduction

The purpose of this study was to investigate how social cohesion, the willingness of members of a society to cooperate with each other in order to survive and prosper (Stanley, 2003), and intimacy among rural adolescents affects the outcomes of a text message intervention aimed at improving dietary intakes. It is known that obesity rates among rural adolescents are higher than obesity rates among urban adolescents and many environmental determinates have been speculated to be major contributing factors. It is also known that peers can have increasing more impact on one another during the period of adolescence. However, there is very little research that looks at the relationship between social cohesion and intimacy as predictors of dietary intakes and weight outcomes, among rural adolescents. This study focuses specifically on rural adolescents in Kentucky and North Carolina and how the number of friends one shares food with, buys food with, and shares information about their life with impacts the outcomes of a dietary focused, 8-week text message intervention featuring affective messages and weekly challenges as a predictor of fruit, vegetable, fast food, and sugar sweetened beverage intake.

This literature review will delve into the research available on this topic while also highlighting the need for this study. The first section will cover the obesity prevalence in adolescents while also addressing diseases determinates, including rural living. The second section will look at the dietary habits of adolescents and rural adolescents in terms of fruit and vegetable intake, sugar-sweetened beverage intake, and fast food intake. The third section will focus on social networks and obesity, specifically

related to adolescents' dietary intake. Then, the final section will look at text messaging interventions and their effectiveness among adolescents and in dietary interventions.

Obesity Prevalence in Adolescents

Despite the copious amount of time and resources that have been funneled into helping control the elevated obesity rates among adolescents, youth around the world are still being plagued by a disease that could haunt them into adulthood. According to the World Health Organization (WHO), the number of obese children and adolescents around the world increased tenfold from 11 million to 124 million from 1975-2016 (WHO, 2017). Within the United States, the Centers for Disease Control and Prevention (CDC) found that the prevalence of obesity among youth aged 2-19 was 18.5% from 2015-2016 (Hales, Carroll, Fryar, & Ogden, 2017). The prevalence was found to be more concentrated among adolescents aged 12-19 (20.6%) and school-aged children aged 6-11 (18.4%) than pre-school aged children (13.9%) (Hales et al., 2017).

Obesity is associated with a variety of comorbidities including metabolic syndrome, type II diabetes mellitus, cardiovascular abnormalities and psychosocial abnormalities; equally important is the fact that adolescence is emphasized as the critical period when these comorbidities develop (Daniels et al., 2005). Without proper intervention, adolescent obesity can quickly become a perpetual disease that can negatively affect one's physical and mental health long-term. Observations show that up to 80% of overweight adolescents will become obese adults (Daniels et al., 2005). Although there are several modifiable and non-modifiable risk factors contributing to obesity, many observational and intervention studies have targeted modifiable risk

factors, such as diet, physical activity, and one's environment, in determining the best epidemiological control mechanisms for this disease.

Obesity Rates Among Rural Communities

While some states have less of an area imbalance when looking at rural versus urban landscapes, both Kentucky and North Carolina have a large portion of their states considered rural by the Department of Agriculture. Within Kentucky, 85 of the 120 counties are considered rural along with 80 of the 100 counties in North Carolina (Davis, 2009; Knopf, 2018). Although research looking at differences in rural versus urban adolescent obesity rates by state is limited, the latest information from America's Health Rankings shows that adult obesity rates among rural adults in Kentucky is 37.7% while adult obesity rates among urban adults is 34.7% (America's Health Rankings, 2018). In North Carolina, the rural, adult obesity rate is 34.9% compared to 32.8% for urban adults (America's Health Rankings, 2018). The rates for urban and rural adult obesity are both higher than the national rates in both states (America's Health Rankings, 2018).

Studies show that rural children are more likely to be overweight or obese than urban children (Probst, Barker, Enders, & Gardiner, 2016). From 2011-2012, self-reported data showed that 39% of youth aged 10-17 living in rural areas were overweight or obese compared to 30% of youth living in urban areas (Ogden et al., 2018). In a 2008 study focused on regional disparities in childhood and adolescent obesity in the United States, it was concluded that children in West Virginia, Kentucky, Texas, Tennessee, and North Carolina were two times more likely to be obese compared to children in Utah, where the rural population is low, that shared similar socioeconomic situations and behaviors (Singh, Kogan, & van Dyck, 2008). By comparing high rural areas to low rural

areas, it is evident that a rural community environment influences overweight and obesity determinants in all ages as demonstrated above (Rural Health Information Hub, 2016).

Obesity Disease Determinates in Rural Communities

Many studies have further examined obesogenic environmental disease determinates in rural populations. Insufficient grocery store access, leading to less food availability for rural residents, and differences in diet and physical activity patterns between rural and urban cultures were found to be contributors to this phenomenon (Probst et al., 2016; Liu et al., 2012). Furthermore, rural residents typically have lower incomes and rural heads of households have completed less high school or college when compared to their urban counterparts (Liu et al., 2012). The current research on obesity in rural adolescents focuses primarily on the discrepancies between rural and urban adolescents in terms of diet, physical activity, income, and education as obesity determinates. There is a very limited amount of research looking into other factors, such as social influences, that affect this disease.

Dietary Habits Among Adolescents and Rural Adolescents

It is known that a diet rich in fruits and vegetables is important for people of all ages. However, it is imperative that adolescents consume adequate amounts to nourish the important growth and development period they are in. Unfortunately, according to data from the Healthy People 2020 objectives, neither fruit nor vegetable mean consumption rates increased in the diets of people aged 2 years and older from 2008-2014 (Healthy People, 2018). More alarming is the fact that in the United States, nearly one-third of vegetable consumption comes from potatoes while one-quarter of fruit consumption comes from fruit juice (Lorson, Melgar-Quinonez, & Taylor, 2009).

Looking at the key recommendations from the 2015-2020 Dietary Guidelines for Americans, it is recommended that vegetables from all subgroups-dark green, orange/red, legumes, starchy, etc.- as well as whole fruits be consumed in mindful portions as part of a healthy eating pattern (United States Department of Agriculture, 2015). Looking at youth, a study focused on obesity outcomes between rural and urban American children found that in general, all United States 12-19-year-olds were eating less than one cup of vegetables per day, less than two cups of fruit per day, and were consuming more than 24 ounces of sweetened beverages per day (Liu et al., 2010). Furthermore, when looking at the trends in fruit and vegetable consumption among different age cohorts, one study found that fruit and vegetable intake trends started to decrease after the age of 7 (when intakes were at their highest point) and did not recover until age 17 to early adulthood (Albani, Butler, Traill, & Kennedy, 2017). Many have hypothesized that these trends are associated with greater freedom in food choice and dining and shopping more often with peers during adolescence. However, results are still equivocal and more research is needed to make further conclusions.

The discrepancies in weight status between rural and urban adolescents is well-known with rural adolescents being at a higher risk for being overweight or obese. Additionally, it is also well-known that dietary habits, among other controllable variables, can positively or negatively influence one's weight status. An observational study that looked into the differences in dietary behaviors between adolescents based on their residential locations found that fewer rural adolescents (12.2%) reported eating two or more cups of fruit per day compared to the urban adolescents (16.5%) (Liu et al., 2010). When looking at rural children aged 2-11 years old also in this study, they consumed

more sugar sweetened beverages than the urban children (Liu et al., 2010). The lack of fruits and vegetables and higher levels of sugar sweetened beverages in the diets of rural residents could be the result of poor infrastructure in rural areas, such as roads and storage that inhibit a constant flow of high-quality produce in the rural food outlets causing more people to rely on energy-dense convenient products (Bardenhagen, Pinard, & Yaroch, 2017). Furthermore, another study looking at fruit and vegetable availability in rural stores in 12 Montana counties using the Nutrition Environment Measures Survey for Stores (NEM-S) found that the least rural stores had the highest mean scores in terms of quality, availability and price of fruits and vegetables (Shanks et al, 2015). This shows that level of rurality could be negatively associated with sufficient access to quality fruit and vegetables. Environmental determinates, such as access to proper infrastructure, could be one of the contributing factors to the more “obesogenic” nature of rural living in terms of the dietary consumption of fruits, vegetables among adolescents.

Looking at fast food, adolescents in the United States tend to eat fast food at least twice per week (Rojas, Castro, Ramos, Aragón, & Raven, 2013). It has been found that adolescents who eat fast food consume more energy, fat, sugar, and sugar-sweetened beverages and less fiber, milk, fruits, and vegetables than adolescents who do not eat fast food (Rojas et al., 2013). While a variety of factors have been attributed to this high fast food intake, peer influence, social norms, and marketing are three of the factors that are thought to heavily influence the establishment of dietary habits during this period of life (Rojas et al., 2013). A longitudinal study looking at fast food intake among children in China found that fast food consumption among 13-17 year olds increased from 17.9% to 26.3% from 2004 to 2009 (Xue, Wu, Wang, & Wang, 2016). While consumption

increased significantly in both urban and rural adolescents, the increase was most rapid in adolescent boys coming from medium-income families living in rural areas (Xue et al., 2016). However, there are not many other studies available looking at differences in fast food consumption between rural and urban adolescents, especially in the United States. Therefore, more research needs to be done before these results can be generalized to other populations. Overall, regardless if one is a rural or urban dweller, it is evident that fast food intake among adolescents is high and could be influenced by peers and social networks.

Social Networks and Obesity

Social networks, consisting of personal and broad interdependencies, have been shown to be impactful on general health and disease protection (Powell et al., 2015). A review looking at the impacts of social networks on obesity found three common social processes within the literature: social contagion, social capital, and social selection (Powell et al., 2015). These three processes are associated with network influences, social support and belonging, and network development, respectively (Powell et al., 2015).

Social Networks among Adolescents

During adolescence, the social processes listed above can be more pronounced as individuals spend time observing, modeling, and imitating behaviors of friends they are spending increasing more time with and that they view as important as a way to gain acceptance and avoid social judgement (Wouters, Larsen, Kremers, Dagnelie, & Greenen, 2010; Perkins, Perkins, & Craig, 2018). Additionally, the results from a study looking at peer influence on snacking behaviors of adolescents highlights this idea. This study, which split participants into friendship groups, found that the amount of snacks

and soft drinks a person consumed was directly related to the amount their close peers consumed (Wouters et al., 2010). This relationship was stronger in adolescent boys and lower in normal weight adolescents (Wouters et al., 2010). Interestingly, a study that looked further into the concept of personal dietary intake being influenced by peers' intake found that there is a lot of misperception concerning the amount of fruits, vegetables, and sugar sweetened beverages people are actually consuming (Perkins et al., 2018). For example, 76% of students in the study overestimated their male peers' consumption of sugar sweetened beverages per day while 68% overestimated their female peers' consumption of sugar sweetened beverages per day (Perkins, et al., 2018). This is a problematic finding considering the amount of current research that suggest peers and social networks have a large impact on adolescent's dietary intake.

Dietary Aspects to Adolescents' Social Networks

When looking at peers and social networks as they relate to dietary intake, much research has been done looking at the role of self-efficacy which is defined as, confidence in the ability to exert control over one's own motivation, behavior and social environment (Carey & Forsyth, n.d.), in this relationship. One study looking at the connection between self-efficacy and peer support for healthy or unhealthy eating in adolescents found that participants who had peers that supported them to eat unhealthy had a decreased self-efficacy that was reflected by them consuming a less-healthy diet (Fitzgerald, Heary, Kelly, Nixon, & Shevlin, 2013). Conversely, a similar study focusing on the influence of parents and friends on adolescents' diets, looking specifically at fruit and vegetable intake, found that the attitudes and behaviors of friends did not affect participants' fruit and vegetable intake (Pedersen, Grønhoj, & Thøgersen, 2015). However, the researchers

believe that the results from this study could have been impacted by asking questions about one's "friends" in general which caused participants to draw one conclusion about the attitudes and behaviors of a potentially large, diverse group of people (Pedersen et al., 2015). The social component of the current study will look at more intimate relationships and cohesion among peers as it relates to dietary outcomes associated with participating in a text message intervention rather than broader peer relationships. This will fulfill a gap in the research and potentially help rectify some of the current contrasting literature.

Use of Text Messaging Interventions

The use of text messaging interventions is on the rise due to their affordability, their potential to reach a large amount of people, and their ability to combine multiple, diverse interventions (Loh et al., 2018). While text messaging interventions are being used for a variety of scopes of study, many have focused on improving weight status and dietary outcomes.

Effectiveness of Text Messaging in Dietary Interventions

One study looking at the effectiveness of smartphone applications and text messaging on weight loss among young adults aged 18-25 found that the treatment group, who tracked their food and exercise using a smartphone application and received varying amounts of personalized text messages from a health-coach, lost an average of 2.7 kg (5.94 lbs.) during the three month intervention period (Stephens, Yager, & Allen, 2017). Comparatively, the control group, who received no text messages and were encouraged not to use a smartphone application, gained an average of 1.5 kg during the three months (Stephens et al., 2017). Furthermore, when looking at a study that utilized a one-way text messaging intervention in obese adults with an average age of 46.9, the treatment group,

which received three text messages per week, had a significant decrease in BMI after 12 weeks (28.0 ± 3.2 to 27.9 ± 0.2) compared to the control group, which had an increase in average BMI after 12 weeks (27.9 ± 2.3 to 28.3 ± 0.2) (Ahn & Choi, 2017). While the first study was much more involved, focusing on increasing self-reporting and self-efficacy in addition to improved obesity outcomes and tailored to individual participants, the second study, which utilized text messaging only, still produced significant results. The results from these two studies show that text messaging interventions, both simple and complex, have been shown to be successful in improving obesity rates among a wide age range of adults.

Adolescent-Specific Interventions and Peer-Impact

The use of text messaging as a global means of communication is becoming increasingly prevalent across all age groups, especially adolescents. A study conducted by the Pew Research Center (2018) found that 95% of teens aged 13-17 have a smartphone or access to a smartphone. Current research shows that text messaging interventions, especially those that are affective in nature, meaning they focus on the positive emotions and feelings associated with a certain behavior, can be effective in improving fruit and vegetable intake among adolescents (Carfora, Caso, & Conner, 2016). However, text messaging interventions that are instrumental in nature, focusing on the physical benefits of a certain behavior, have also been shown to be significant in improving fruit and vegetable intake among this population, although not as significant as their affective counterparts (Carfora et al., 2016). Furthermore, other types of text messaging interventions have also proven to be successful among adolescents. Text messages acting as a commitment device, nudges asking people to commit to certain behaviors or

activities, were shown to be more effective in helping obese adolescents maintain their weight loss compared to text messages that delivered information only (Kulendran et al., 2016). Overall, a variety of text messaging interventions focused on obesity rates and dietary outcomes have been shown to be successful among adolescents. However, there is a current gap in the research concerning how one's level of social cohesion and intimacy with their peers can affect how receptive they are to text messaging interventions, specifically those associated with dietary intake.

As previously stated, much of the current research concerning the use of text messaging interventions to improve dietary intakes and weight outcomes shows promising results for this mode of intervention. Despite that, there is not much research currently available that looks at the role peers can play in impacting the effectiveness of this type of intervention, especially in adolescents. However, one qualitative study gathered preliminary data about adolescents' perspectives of text messages used in interventions in order to gather information that could be used to construct text messages for a future randomized control trial of a 6-month weight loss intervention. This study, which utilized focus groups for data collection, found that the adolescents' preferred directive text messages that told them exactly what to do as well as the text messages that featured recipes and testimonies (Woolford et al. 2012). Looking further into the effects of peers, the study also found that the adolescents unanimously agreed that stating that "a teen said" or "a peer said" would help them to relate to the messages more and would improve their self-efficacy in incorporating a certain routine or behavior into their own life (Woolford et al., 2012). While this is one of the only studies of its kind, it does show evidence that peers can impact the effectiveness of text message interventions in terms of

text message content and degree of relatability. While more research is needed to determine the other impacts peers can have, this current study will begin to fill the gap in the research by looking at the effect that varying levels of social cohesion and intimacy among peers at the beginning of the study can have on the outcomes of a text-message intervention aimed at improving dietary intakes.

Summary

After reviewing the available literature, it is evident that adolescent obesity is a health issue of concern within the United States and is more prominent in rural adolescents due to a variety of environmental determinates, such as access to sufficient, quality, fruits and vegetables. It is also evident that social cohesion among adolescents could be more prominent during this life stage as peers begin spending increasing more time with their peers and may begin to model their behaviors as a way of fitting in. However, there is still a gap in the research pertaining to how social cohesion and intimacy among rural adolescent peers affects dietary intakes and weight outcomes, specifically in-terms of a text message intervention. Fulfilling the purpose of this study will lead to a better understanding of the effects of social cohesion and intimacy on dietary intakes and weight outcomes among rural adolescents. Results from this study can be used to inform future interventions targeting obesity within this population.

Chapter Three: Methodology

Research Design

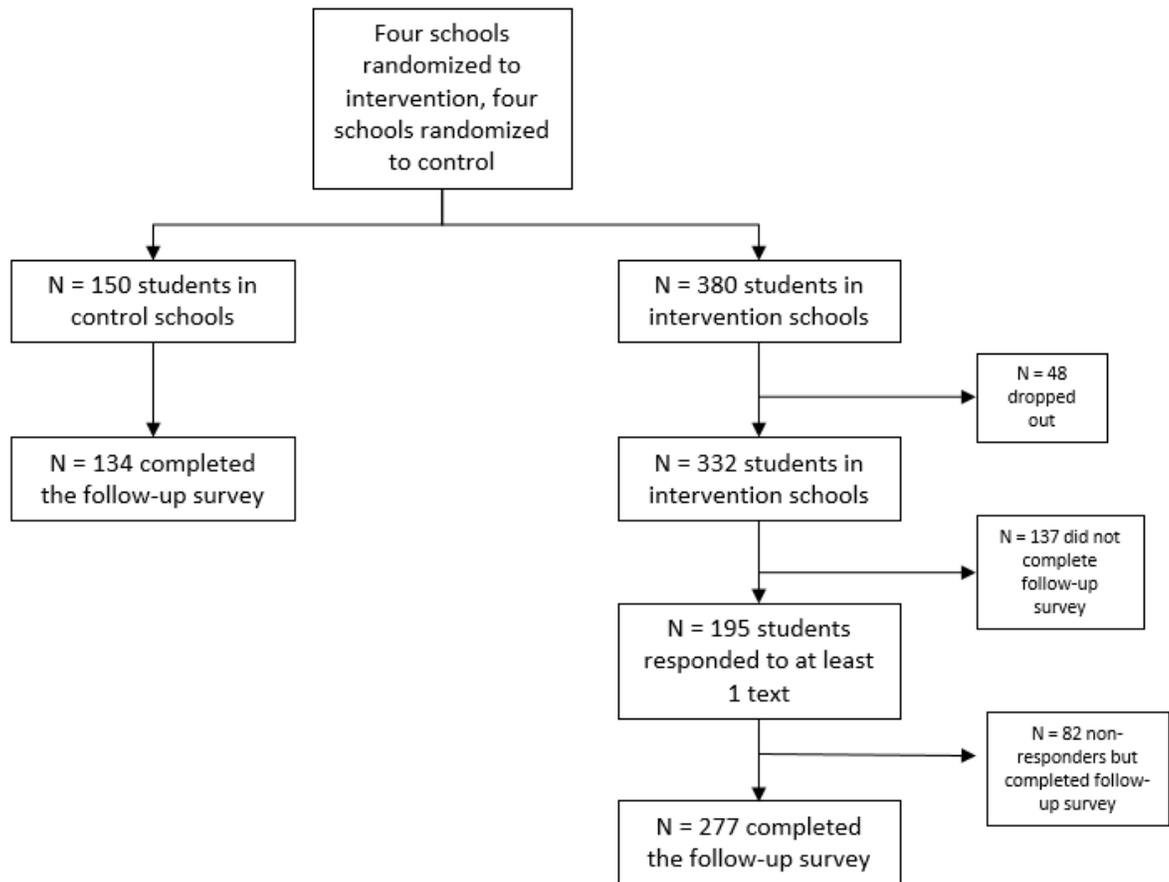
Using a randomized controlled trial with repeated measures design, this pilot study measured the effect of social cohesion on a dietary focused text message intervention among rural adolescents in Kentucky and North Carolina. A survey was developed to gather baseline and post intervention information about dietary intakes, social networking, anthropometrics, and demographics. Dietary intakes were assessed using the National Institute of Health's Eating at America's Table Quick Food Scan. An 8-week text message intervention was constructed and administered to the intervention group. Results from the baseline and post surveys were analyzed for both the control and intervention groups to gain insight on the association between social cohesion and dietary intakes and weight outcomes among rural adolescents.

Participants

Eight schools in four rural Kentucky counties and three rural North Carolina counties were partnered with for this study. Students were recruited through their high school class, at the start of school orientation session, and via email. Inclusion criteria included being English speaking, 14-16 years old, residing in the country for at least one year, reporting no immediate plans to move out of the country, reporting no chronic diseases, and agreeing to download the GroupMe™ application. Each school was entered into a randomization scheme with an equal chance of being selected as an intervention site. Four schools were dedicated as control sites and four schools were dedicated as intervention sites. Parental permission was required to participate in the study. Participants also had to complete an assent form which was included at the

beginning of the survey. Students received \$25 for participating in the baseline survey and \$30 for participating in the post intervention survey. Among the control and intervention groups, 411 adolescents completed the baseline and post intervention surveys.

Figure 3.1: Participant Distribution



(Gustafson, Pitts, McQuerry, Babatunde, & Mullins, 2017)

Measurements

The study survey was approved by the University of Kentucky Institutional Review Board and was administered to all participants in the control and intervention groups at the beginning of the study and at the conclusion of the 8-week intervention. The

survey included questions concerning demographics, social networking, self-reported anthropometrics, and food frequency. The target time for survey completion was 30-40 minutes.

Independent Variable-Social Networking

Within the social networking section of the survey, participants were asked a 3-tiered set of questions. The first question asked participants to list the name and grade of up to four friends they tend to eat food with. The second question asked them to list the friends listed in question one that they also tend to buy food with whether to eat right then or later. The third question asked them to list the friends from question one that they also share lots of information about their life with (Appendix A).

Dependent Variable-Dietary Intake

Participants were then given a food frequency questionnaire to assess how often and how much they consumed fruits and vegetables, fast food, and sugar sweetened beverages in the last week. For example, participants were asked to select how often they ate fruit in the last week with options ranging from never last week to 5 or more times per day. They were then asked to select their serving size with options ranging from less than $\frac{1}{2}$ a cup to more than 1 cup (Appendix B).

Intervention

Participants assigned to the intervention group received two text messages per week on Tuesdays and Saturdays for 8 weeks via the GroupMe™ social media app. The design for the intervention was grounded in the Social Cognitive Theory and used a mentor-led approach. The mentors were 34 undergraduate students in the Department of Dietetics and Human Nutrition who were under the supervision of 4 graduate students

also in the department. The intervention featured affective messages focusing on promoting self-efficacy and goal-setting as it relates to dietary intake. Weekly challenges focusing on eating fruits and vegetables and consuming healthy beverages were also implemented. For example, one text message used in the intervention was “*I had an apple today, what fruit were you able to eat today?*” After the template message was sent out, mentors would respond appropriately to any responses they received. Participants were not required to respond but responses and message interactions were tracked. Participants in the control group did not receive any text messages throughout the study.

Statistical Analysis

Statistical analysis for this study was conducted using the StataSE™ software. Demographic frequency distributions were constructed for both the control and intervention groups. The social networking data collected was used to generate a social cohesion variable. Participants were categorized as having high or low social cohesion based on the first social networking question. Those who listed two or more friends for question 1 were considered to have high social cohesion while those who listed less than two friends were considered to have low social cohesion. A second variable, food cohesion, was then generated based on social cohesion and a cut point of sharing intimate details and sharing food (questions 2 and 3). Those who listed two or more friends for both questions 2 and 3 were considered to have high food cohesion while those who listed less than two friends for one or both questions were considered to have low food cohesion.

Simple linear regression was used for the within group analysis to determine the association between each dietary variable, fruit and vegetable intake, sugar sweetened

beverage intake, and fast food intake, and food cohesion for both the control and intervention groups at baseline and post intervention. Then, a linear regression model was used to determine the association between dietary intake and food cohesion for those in the intervention group with high food cohesion compared to those in the control group with high food cohesion. The tests were controlled for age, gender and race. Correlation coefficients and p-values for the control and intervention groups from baseline to post intervention were compared for significance. Additionally, correlation coefficients between the two groups post intervention were compared to determine how intake changed in terms of serving sizes and calories. For ease of interpreting, the coefficients were back transformed out of the natural log format. Results were analyzed to determine how fruit and vegetable intake, sugar-sweetened beverage intake, and fast food intake varied within and between both the control and intervention groups in terms of level of food cohesion.

Chapter Four: Results

A total of n=411 students took part in the study. The intervention group contained n=277 participants while the control group contained n=134 participants. Descriptive statistics for the two groups are summarized in Table 4.1. Within the intervention group, 71.74% of participants were white, while 55.04% of participants in the control group were white. Both groups contained more females than any other gender, with females comprising 61.73% of the intervention group and males comprising 38.27% of the intervention group. Similarly, the control group contained 67.91% females, 30.60% males, and 1.5% other. The average age in the intervention group was slightly higher than that of the control group at 15.73 years compared to 14.99 years.

Based on the results shown in Table 4.2, there was no significant effect between level food cohesion and the dietary variables within the intervention group. However, within the control group there was a significant association between food cohesion and fruit and vegetable intake. Those with high food cohesion in the control group consumed around 0.513 (95% CI: 0.088-0.938) more servings of fruits and vegetables per week compared to those in the control group with low food cohesion. The between groups analysis showed that those with high food cohesion in the intervention group consumed fast food around 0.381 (95% CI: -0.710-0.051) less times per week compared to those in the control group with low food cohesion.

Table 4.1: Descriptive characteristics of students enrolled in the Go Big and Bring It Home text messaging intervention that completed social cohesion variables

Demographics	Intervention n=277	Control n=134	
Race			
White	71.74%	55.04%	p=.01
Other	28.16%	44.96%	
Gender			
Female	61.73%	67.91%	p=.7
Male	38.27%	30.60%	
Other	0%	1.5%	
Average Age in Years	15.73	14.99	p=.8

Table 4.2: Association between dietary variables and level of food cohesion for control and text messaging intervention groups

	Intervention		Control		Between Groups	
	Coef. (p-value)	95% Confidence Interval	Coef. (p-value)	95% Confidence Interval	Coef. (p-value)	95% Confidence Interval
Fruit and Vegetable Consumption	-0.070 (0.678)	-0.401-0.262	0.513 (0.018)*	0.088-0.938	-0.537 (0.06)	-1.090-0.017
Fruit and Vegetable Purchases	-0.047 (0.660)	-0.259-0.164	0.059 (0.720)	-0.265-0.382	-0.081 (0.666)	-0.451-0.288
Calories from Beverages	-0.254 (0.222)	-0.663-0.155	0.356 (0.207)	-0.200-0.912	-0.636 (0.072)	-1.329-0.057
Sugar Sweetened Beverage Calories	-0.220 (0.314)	-0.651-0.210	0.353 (0.290)	-0.306-1.011	-0.585 (0.129)	-1.341-0.171
Fast Food Times Per Week	-0.166 (0.09)	-0.357-0.026	0.197 (0.159)	-0.079-0.473	-0.381 *(0.024)	-0.710— 0.051
*Indicates p<.05						

Chapter Five: Discussion

The purpose of this study is to investigate how social cohesion and intimacy among rural adolescents in Kentucky and North Carolina affects the outcomes of a text message intervention aimed at improving fruit, vegetable, fast food and sugar sweetened beverage intake. Results indicated that there was no significant effect between food cohesion and the dietary variables of interest within the intervention group. However, there was a modest effect on fast-food trips per week between those with high food cohesion in the intervention group compared to those with low food cohesion in the control group and on fruit and vegetable consumption between those with high food cohesion in the control group compared to those with low food cohesion in the control group. Although hypothesis two proved to be incorrect, as there was no significant dietary improvements between those with varying levels of social cohesion within the intervention group, and hypothesis one was only significant in terms of fast food consumption, the results from this study still contributed useful information to the existing literature.

The research to date has found that eating behaviors and the feelings of self-efficacy around consuming a healthy diet among adolescents are influenced by peers. The modest effect on the amount of fast food consumed per week among those with high food cohesion in the intervention group is consistent with results from other studies (Macdiarmin et al., 2015). Wanting to be with friends was one of the primary reasons students reported going to the supermarket rather than a fast food location in a survey concerning lunchtime behaviors in Scotland (Macdiarmin et al., 2015). Perceptions about norms concerning fruit and vegetable intake and physical activity have also been found to be associated with health-promoting behaviors among teens (Rice & Klein, 2019). Concerning meal-skipping

and healthy eating patterns, researchers in Australia concluded that the social environment is more prominent in establishing healthy eating patterns, likely due to shared beliefs among friends and observable behaviors, compared to providing generalized nutrition advice (Rosenrauch, Ball, & Lamb, 2016). Compared to those with high food cohesion in the intervention group, those with low food cohesion in the control group likely did not experience the same influence of the social environment on eating behaviors. Someone who does not buy or share food often with others is probably more likely to choose the convenience of a fast food meal rather than purchasing and preparing a meal. However, further research is needed to confirm this finding.

Limitations & Future Work

What is innovative about the current study is that it looked at how sharing food and personal information may influence dietary intake among rural adolescents. It delved beyond the label of simply being friends with someone and looked at how deeper connections among adolescents affect dietary intakes. Although the results linking dietary intake and food cohesion proved to be non-significant, this study, being one of the first of its kind, contributed useful results to the existing literature and laid the foundation for future studies. It is hypothesized that the lack of significance could have been the result of incorrectly defining food cohesion, inefficient surveying methods, or using an individual focused intervention.

In this study, high food cohesion was defined as having two or more friends with whom one shares food and intimate details, while low food cohesion was defined as having one or fewer friends with whom one shares food and intimate details. However, this variable was created specifically for this study based on participants' social

networking in terms of who they tend to eat food with, buy food with and share lots of information with about their life. The funneling question method that was used could have been confusing for participants and also difficult to answer for fear of leaving someone out due to there only being 4 spaces to list friends for each social networking question. Future studies could avoid using such a specific naming method in order to gather richer, more encompassing details about participants' social networks that can be used to better define participants' level of food cohesion. Additionally, since the food cohesion variable was unique to this study, there is no means of comparison to determine if the definition was accurate. Seeing that high and low cohesion was arbitrarily defined, there is no way to know if the definition was correct.

The intervention employed in this study focused on the one-on-one text message communication between a graduate student and a participant. Since the purpose of this study was to look at how deep, interpersonal relationships among rural adolescents affected the outcome of the text message intervention in terms of dietary intakes, a group messaging approach, in which friends could engage in conversations about the dietary-focused information with the graduate student and their friends, could have been more appropriate and yielded significant results. Additionally, data was only collected at baseline and after the 8-week intervention period. No further follow up was done to determine if changes in dietary intakes persisted after the intervention.

Future studies could implement a 6 month and 12 month follow-up period which would give a more thorough insight into the long-term effects of the study. Additionally, the survey portion of the study utilized a food frequency questionnaire. Although the questionnaire was created using validated sources, this type of dietary assessment is

prone to recall bias and measurement error and is very tedious to complete. Therefore, the dietary intake data gathered could have been inaccurate. For future studies, researchers could decrease the scope to look at one dietary variable and utilize a more accurate dietary assessment, such as a dietary scanner, to increase the reliability of the results.

Public Health Implications

Due to a lack of research looking specifically at the role of social cohesion and dietary intake among rural adolescents, it is difficult to determine the extent to which interdependence among peers influences food choices. However, the positive associations between food cohesion and fast food intake within the intervention group and between food cohesion and fruit and vegetable intake within the control group cannot be ignored. Looking beyond the intervention utilized in this study, recognizing the social contribution at play is important for structuring future public health work focused on this population. Future interventions could focus more on providing information about the social component of dietary intakes rather than simply providing dietary information.

Appendices

Appendix A

SOCIAL NETWORKING

Which of your friends do you tend to eat food with? (give their first and last name and the grade they are in)

1. First Name: _____ Last Name: _____ Grade: _____
2. First Name: _____ Last Name: _____ Grade: _____
3. First Name: _____ Last Name: _____ Grade: _____
4. First Name: _____ Last Name: _____ Grade: _____

Of these people listed which ones do you tend to buy food with whether to eat now or later?

1. First Name: _____ Last Name: _____ Grade: _____
2. First Name: _____ Last Name: _____ Grade: _____
3. First Name: _____ Last Name: _____ Grade: _____
4. First Name: _____ Last Name: _____ Grade: _____

Of the friends listed which ones do you share lots of information about your life with?
Examples are when you are upset with your family, if you do poorly on a test.

1. First Name: _____ Last Name: _____ Grade: _____
2. First Name: _____ Last Name: _____ Grade: _____
3. First Name: _____ Last Name: _____ Grade: _____
4. First Name: _____ Last Name: _____ Grade: _____

Appendix B

INSTRUCTIONS

- Think about what you usually ate last month.
- Please think about all the fruits and vegetables that you ate last month. Include those that were:
 - raw and cooked,
 - eaten as snacks and at meals,
 - eaten at home and away from home (restaurants, friends, take-out), and
 - eaten alone and mixed with other foods.
- Report how many times per month, week, or day you ate each food, and if you ate it, how much you usually had.
- If you mark "Never" for a question, follow the "Go to" instruction.
- Choose the best answer for each question. Mark only one response for each question.

1. Over the last month, how many times per month, week, or day did you drink **100% juice** such as orange, apple, grape, or grapefruit juice? **Do not count** fruit drinks like Kool-Aid, lemonade, Hi-C, cranberry juice drink, Tang, and Twister. Include juice you drank at all mealtimes and between meals.

- | | | | | | | | | | |
|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|
| <input type="radio"/> |
| Never | 1-3 | 1-2 | 3-4 | 5-6 | 1 | 2 | 3 | 4 | 5 or more |
| (Go to | times | times | times | times | time | times | times | times | times |
| Question 2) | last month | per week | per week | per week | per day |

1a. Each time you drank **100% juice**, how much did you usually drink?

- | | | | |
|---|---------------------------------|-----------------------------------|---|
| <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Less than ¼ cup
(less than 6 ounces) | ¾ to 1¼ cup
(6 to 10 ounces) | 1¼ to 2 cups
(10 to 16 ounces) | More than 2 cups
(more than 16 ounces) |

2. Over the last month, how many times per month, week, or day did you eat **fruit**? Count any kind of fruit—fresh, canned, and frozen. **Do not count** juices. Include fruit you ate at all mealtimes and for snacks.

- | | | | | | | | | | |
|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|
| <input type="radio"/> |
| Never | 1-3 | 1-2 | 3-4 | 5-6 | 1 | 2 | 3 | 4 | 5 or more |
| (Go to | times | times | times | times | time | times | times | times | times |
| Question 3) | last month | per week | per week | per week | per day |

2a. Each time you ate **fruit**, how much did you usually eat?

- | | | | |
|--------------------------|-----------------------|-----------------------|---------------------------|
| <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Less than 1 medium fruit | 1 medium fruit | 2 medium fruits | More than 2 medium fruits |
| <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Less than ½ cup | About ½ cup | About 1 cup | More than 1 cup |
- OR**

7. Over the last month, how often did you eat **other vegetables**?

- DO NOT COUNT:**
- Lettuce salads
 - White potatoes
 - Cooked dried beans
 - Vegetables in mixtures, such as in sandwiches, omelets, casseroles, Mexican dishes, stews, stir-fry, soups, etc.
 - Rice

COUNT: • All other vegetables—raw, cooked, canned, and frozen

Never
(Go to Question 8)

1-3 times last month

1-2 times per week

3-4 times per week

5-6 times per week

1 time per day

2 times per day

3 times per day

4 times per day

5 or more times per day

7a. Each of these times that you ate **other vegetables**, how much did you usually eat?

Less than ½ cup

½ to 1 cup

1 to 2 cups

More than 2 cups

8. Over the last month, how often did you eat **tomato sauce**? Include tomato sauce on pasta or macaroni, rice, pizza and other dishes.

Never
(Go to Question 9)

1-3 times last month

1-2 times per week

3-4 times per week

5-6 times per week

1 time per day

2 times per day

3 times per day

4 times per day

5 or more times per day

8a. Each time you ate **tomato sauce**, how much did you usually eat?

About ¼ cup

About ½ cup

About 1 cup

More than 1 cup

9. Over the last month, how often did you eat **vegetable soups**? Include tomato soup, gazpacho, beef with vegetable soup, minestrone soup, and other soups made with vegetables.

Never
(Go to Question 10)

1-3 times last month

1-2 times per week

3-4 times per week

5-6 times per week

1 time per day

2 times per day

3 times per day

4 times per day

5 or more times per day

9a. Each time you ate **vegetable soup**, how much did you usually eat?

Less than 1 cup

1 to 2 cups

2 to 3 cups

More than 3 cups

10. Over the last month, how often did you eat **mixtures that included vegetables**? Count such foods as sandwiches, casseroles, stews, stir-fry, omelets, and tacos.

Never

1-3 times last month

1-2 times per week

3-4 times per week

5-6 times per week

1 time per day

2 times per day

3 times per day

4 times per day

5 or more times per day

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Thank you very much for completing this questionnaire.
Please return it in the enclosed, postage-paid envelope or to the address listed on the front page.

3. Over the last month, how often did you eat **lettuce salad (with or without other vegetables)**?

- Never
(Go to Question 4)
- 1-3 times last month
- 1-2 times per week
- 3-4 times per week
- 5-6 times per week
- 1 time per day
- 2 times per day
- 3 times per day
- 4 times per day
- 5 or more times per day

3a. Each time you ate **lettuce salad**, how much did you usually eat?

- About 1/2 cup
- About 1 cup
- About 2 cups
- More than 2 cups

4. Over the last month, how often did you eat **French fries or fried potatoes**?

- Never
(Go to Question 5)
- 1-3 times last month
- 1-2 times per week
- 3-4 times per week
- 5-6 times per week
- 1 time per day
- 2 times per day
- 3 times per day
- 4 times per day
- 5 or more times per day

4a. Each time you ate **French fries or fried potatoes**, how much did you usually eat?

- Small order or less
(About 1 cup or less)
- Medium order
(About 1 1/2 cups)
- Large order
(About 2 cups)
- Super Size order or more
(About 3 cups or more)

5. Over the last month, how often did you eat **other white potatoes**? Count **baked, boiled, and mashed potatoes, potato salad, and white potatoes that were not fried**.

- Never
(Go to Question 6)
- 1-3 times last month
- 1-2 times per week
- 3-4 times per week
- 5-6 times per week
- 1 time per day
- 2 times per day
- 3 times per day
- 4 times per day
- 5 or more times per day

5a. Each time you ate **these potatoes**, how much did you usually eat?

- 1 small potato or less
(1/2 cup or less)
- 1 medium potato
(1/2 to 1 cup)
- 1 large potato
(1 to 1 1/2 cups)
- 2 medium potatoes or more
(1 1/2 cups or more)

6. Over the last month, how often did you eat **cooked dried beans**? Count **baked beans, bean soup, refried beans, pork and beans and other bean dishes**.

- Never
(Go to Question 7)
- 1-3 times last month
- 1-2 times per week
- 3-4 times per week
- 5-6 times per week
- 1 time per day
- 2 times per day
- 3 times per day
- 4 times per day
- 5 or more times per day

6a. Each time you ate **these beans**, how much did you usually eat?

- Less than 1/2 cup
- 1/2 to 1 cup
- 1 to 1 1/2 cups
- More than 1 1/2 cups

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