IRRER, TINA. Ph.D. The Association of Fathers' Nutrition Knowledge and Father Food-Parenting Practices with Child BMI Percentile. (2022)
Directed by Dr. Lauren Haldeman. 131 pp.

This study examined North Carolina fathers of school-aged children (6-11 years) with a focus on father nutrition knowledge and food-parenting practices and whether there was an association with changes in child BMI percentile. Father coercive control practices, including restriction of foods, pressure to eat, and use of bribes to encourage child eating were not significantly related to estimated increases in child BMI percentiles ($p = 0.0609$). Higher father nutrition knowledge was associated with a modest decrease in child BMI percentile ($p = 0.0064$). Father diet quality was evaluated in a subset of families ($n = 51$). Father diet quality was scored according to the HEI-2015 diet quality index. The average father diet score was 58.62 which is consistent with the average HEI-2015 score of 58 for American adults aged 18-64 years; however, this diet quality score falls short of aligning with *2015-2020 The Dietary Guidelines for Americans*. Fathers play a role in healthy child weight outcomes and should be considered in the development of family-based childhood obesity prevention education.

THE ASSOCIATION OF FATHERS' NUTRITION KNOWLEDGE AND FATHER FOOD-PARENTING PRACTICES WITH CHILD BMI PERCENTILE

by

Tina Irrer

A Dissertation

Submitted to

the Faculty of The Graduate School at

The University of North Carolina at Greensboro

in Partial Fulfillment

of the Requirements for the Degree

Doctor of Philosophy

Greensboro

2022

Approved by

Dr. Lauren Haldeman
Committee Chair

APPROVAL PAGE

This dissertation written by Tina Irrer has been approved by the following committee of the Faculty of The Graduate School at The University of North Carolina at Greensboro.

Committee Chair

Dr. Lauren Haldeman

Committee Members

Dr. Cheryl Buehler

Dr. Jared McGuirt

Dr. Lenka Shriver

June 23, 2022

Date of Acceptance by Committee

January 13, 2022

Date of Final Oral Examination

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CHAPTER I: A REVIEW OF THE LITERATURE

The influence of parents and families on lifestyle behaviors that develop in children as they progress from infancy to adulthood is generally accepted (Davison et al., 2016). Lifestyle behaviors include diet, physical activity, screen time, and sleep patterns (Davison et al., 2016). In recent years, however, household structure and the parenting roles of mothers and fathers have blurred in response to several factors such as increased maternal employment and paternal caregiving participation (Davison et al., 2016). Fathers increasingly participate in food and meal responsibilities for their children, including food shopping, meal planning, and determining child portion sizes (Khandpur et al., 2016). A 2013 U.S. National Statistics Report evaluated a nationally representative sample of fathers to assess the level of involvement with their children (Jones & Mosher, 2013). The report found that greater than 70% of fathers residing with their children, aged five years or younger, fed or ate with their child every day for the previous four weeks (Jones & Mosher, 2013). Additionally, a 2016 Pew Research Center study found an increasing number of stay-at-home parents are fathers (Livingston, 2018). In 2016, the number of stay-at-home fathers was 17% as compared to 10% in 1989 (Livingston, 2018). Outside of unemployment and economic factors, an increasing number of stay-at-home fathers (24%) reported the decision to stay home was attributed to a "desire to care for their family" (Livingston, 2018). Further, the choice to stay at home was higher among Millennial than Gen X stay-at-home fathers, at 26% and 23%, respectively (Livingston, 2018).

The gap in paternal representation in childhood obesity research has resulted in a lack of insight into the contribution and role of fathers in shaping childhood obesity-related behaviors (Davison et al., 2016). Of those studies that included fathers, diet was not a primary focus, and

the samples included mostly white, middle-class fathers and did not include recipients of federal assistance programs (Davison et al., 2016). Thus, there is a significant gap for lower socioeconomic and minoritized fathers who are generally at a higher risk of overweight and obese weight status (Davison et al., 2016). Furthermore, many existing family interventions are based on maternal data (Davison et al., 2016). Interventions designed for the family, but based predominantly on maternal data, may limit program efficacy, result in content not relevant to fathers, and potentially decrease father participation (Davison et al., 2016).

Fathers are increasingly participating in child-feeding responsibilities and express interest to participate in the care of their children (Davison et al., 2016). Of 436 fathers who participated in a recent Father Feeding Study, 71% responded they should share equal responsibility with the mother when feeding their pre-school aged child, and 26% were interested in increasing their participation in feeding their child (Peeters et al., 2019).

Fathers' increased interest and involvement in child feeding might be attributed, in part, to changes in ways that both parents earn income and care for children (Davison et al., 2016). A recent report found that only 27% of couples with children younger than 18 relied solely on the father's income (Livingston & Parker, 2019). Fathers increasingly participate in food and meal responsibilities, including food shopping, meal planning, and determining child portion sizes (Khandpur et al., 2014). Mallan et al. found that 50% of Australian fathers (n = 436) reported responsibility for deciding foods and portion sizes for their pre-schooled aged child at least half of the time (Mallan et al., 2014).

Obesity

According to 2016 NHANES data, approximately 40% of adults and 19% of children and adolescents are obese (Hales et al., 2017). Further, obesity disproportionately impacts African

American (AA) and Hispanic children with the reported prevalence to be 22% and 26%, respectively, compared to non-Hispanic white children at 14% (CDC, 2019c). Obese children are susceptible to developing hypertension, hyperlipidemia, type 2 diabetes, asthma, musculoskeletal issues, fatty liver disease, anxiety, depression, low self-esteem, bullying, and stigma during childhood (CDC, 2019c). Additionally, overweight and obese children aged 6 -11 years have an increased risk for early puberty (Chen et al., 2019). Along with a greater likelihood of obesity into adulthood, the risk factors for disease in adulthood are more severe for obese children (CDC, 2019c). A recent meta-analysis concluded higher childhood weight status was associated with a greater risk of adult obesity (OR: 5.21, 95% CI 4.50 - 6.02) (Simmonds et al., 2015).

Obesity is not only a significant health concern but is a substantial financial burden. Cost-of-illness studies have determined the healthcare costs associated with obesity related illnesses increased by 27% between 1987 and 2001(Kim & Basu, 2016). Recent estimates project obesity and related illness will account for greater than 20% of the 2018 U.S. healthcare costs, or $344 billion, with over $140 billion related to childhood obesity (CDC, 2019b).

Childhood overweight and obesity status is significantly associated with parents' weight status (Freeman et al., 2012). However, father's weight status may have greater implications on childhood weight status than maternal weight status (Freeman et al., 2012). Freeman et al. (2018) observed parenting couples' weight status in relation to child obesity risk over four years. A child with an overweight father (OR: 4.18; 95% CI: 1.01-17.33; $p = 0.04$) or obese father (OR: 14.88; 95% CI: 2.61-84.77; $p = 0.002$), but a healthy weight mother, had a higher risk of obesity (Freeman et al., 2012). Conversely, the risk of child obesity was not significant when the

mother was obese or overweight and the father had a healthy weight status (Freeman et al., 2012).

Families

Families function as the building blocks of society and serve as the most basic economic unit, a source of belonging and security, and as a critical component of the socialization process for children (Moore et al., 2008). Although characterizations of modern families are broad and flexible, families are generally categorized in three ways: biological, social, and kinship (Cook & Douglas, 1998). The generally accepted legal and institutional understanding of family is organized around marital and biological relationships (Cook & Douglas, 1998). Families organized around social relationships implies fulfillment of social roles and socialization functions (Cook & Douglas, 1998). Families founded in social relationships may apply to individuals who cohabitate and/or form domestic partnerships, share resources, values, and goals over a period of time (Moore et al., 2008). Last, families based on kinship includes households of kin and non-kin in tribal groups or communities (Dilworth-Anderson et al., 1993). Kinship family structures are common among Native American, Black, and Hispanic families (Dilworth-Anderson et al., 1993). Whether the family structure is biological, social, or kinship, child lifestyle behaviors are shaped by their family household.

Parenting

Family household structures and parenting roles have evolved in recent decades in response to several factors. Traditionally, fathers served as the primary breadwinner while mothers were the primary caretakers of the home and children (Vollmer et al., 2015). Over the past five decades, family and household structures have changed in response to increases in women's employment and education attainment (Davison et al., 2016; Pew Research Center,

2015; Yogman & Garfield, 2016). In 2015, about 70% of mothers with children under the age of 18 were employed, as compared to 47% in 1975 (Pew Research Center, 2015). Further, among different-sex, married couples, it is increasingly common for women to have the higher levels of education and income than men (Pew Research Center, 2015). Additionally, other factors, such as the Great Recession of 2008, have impacted fathers' employment and led to an increase in stay-at-home dads (Yogman & Garfield, 2016). Consequently, household structure and the parenting roles of mothers and fathers have blurred in response to these social and economic factors resulting in increased paternal caregiving participation (Davison et al., 2016).

Fathering

A father is broadly defined as the male that is most involved in contributing to the well-being and caregiving of a child, regardless of the biological relationship, marital status, or living situation (Yogman & Garfield, 2016). Fatherhood implies a biological relationship whereas fathering implies the active and intentional involvement of a man in the aims, goals, and plans of a child, regardless of the biological relationship (Day et al., 2005). Variations in fathering practices occur on the basis of race, ethnicity, age, sexual orientations, and socioeconomic status (Day et al., 2005). Over the past few decades, men's involvement in the life of their child occurs within diverse family structures (Day et al., 2005).

Fathers play an important role in the health of their children especially as it relates to diet, exercise, play, and parenting behaviors (Yogman & Garfield, 2016). Although mothers continue to contribute to the majority of childcare and housework activities, fathers' participation has increased and is characterized as a "new fatherhood" (Yogman & Garfield, 2016). For example, when comparing 1965 and 2016 contributions to housework and childcaring activities, time spent by fathers increased from 4 to 10 hours, and 2.5 to 8 hours per week, respectively

(Livingston & Parker, 2019). Further, fathers are increasingly participating in food and meal responsibilities for their children, including food shopping, meal planning, and determining child portion sizes (Khandpur et al., 2016).

Interest in engaging fathers in family-based obesity prevention research is increasing among researchers, community stakeholders, and health professionals (Peeters et al., 2019). The inclusion of fathers who are representative of diverse racial and ethnic populations, varied socioeconomic backgrounds, and family structures is critical to best analyze the role of fathers in child feeding and weight-related behaviors (Peeters et al., 2019). In recognition of the increasing number of men involved in child food management responsibilities, SNAP-Ed educators recently conducted a needs assessment to evaluate nutrition education programming needs for lower-income men (Krall et al., 2015). The SNAP-Ed educators determined that education modules tailored to men should be interactive, provide quizzes with feedback, include goal setting and reflective activities, and include online components, especially for fathers under age 40 (Krall et al., 2015). Krall et al. (2015) recommended including needs specific to low-income males when planning, designing, and funding nutrition education programs. Although not specific to childhood obesity strategies, the SNAP-Ed study reinforces the need for paternal-specific nutrition education strategies.

Food-Parenting Practices

Food-parenting practices include the intentional and unintentional behaviors utilized by parents to manage what, when, and how much a child eats (Vaughn et al., 2016). Several cross-sectional studies have found that facilitating regulation and promotion of child autonomy are associated with a healthy child weight, whereas parents coercive control strategies are associated with child weight problems (Khandpur et al., 2014; Vaughn et al., 2016). The literature,

however, is limited primarily to mothers' rather than fathers' food-parenting practices (Khandpur et al., 2014).

Food parenting practices can be defined by three constructs: coercive control, structure, and autonomy support (Vaughn et al., 2016). Coercive control includes parent-centered dominance or control relative to the child's feelings, thoughts, and behaviors (Vaughn et al., 2016). Coercive control includes parent-centered practices of restriction, pressure to eat, threats and bribes, and using food to control negative emotions (Vaughn et al., 2016). The construct of autonomy support includes parental promotion of the child's independence and psychological autonomy (Vaughn et al., 2016). Autonomy support includes parental practices of child involvement, encouragement, praise, reasoning, negotiation, nutrition education (Vaughn et al., 2016). The construct of structure includes consistent parent reinforcement of rules and boundaries to guide child dietary behaviors (Vaughn et al., 2016). Structure includes parental practices of rules and limits, limited and guided choices, monitoring, meal and snack routines, modeling dietary intake, food availability, food accessibility, and food preparation (Vaughn et al., 2016).

Parent Nutrition Knowledge

Nutrition knowledge is familiarity with the benefits of different foods and beverages and the benefits associated with positive health outcomes. Nutrition knowledge is a factor in food selection and dietary intake (Spronk et al., 2014). A higher degree of nutrition knowledge has been associated with increased fruit and vegetable intake and decreased intake of sugar-sweetened beverages and fats (Spronk et al., 2014).

Historically, nutrition knowledge has generally been higher among women than men due to their dominant role in food purchasing and preparation (Spronk et al., 2014). Other factors

influencing nutrition knowledge include age, educational attainment, and socioeconomic status (Spronk et al., 2014). A study including Medicaid-insured obese children found poorer parent nutrition knowledge was associated with less education and low household income (Cluss et al., 2013). Parent knowledge about general nutrition concepts was also found to be an important factor in the purchase and preparation of nutritious foods for their children (Cluss et al., 2013).

Parent nutrition knowledge has been correlated with child weight status (Variyam, 2001). The USDA assessed the nutrition knowledge of parents with children 6-17 years old via the Diet and Health Knowledge Survey (Variyam, 2001). Although the study did not differentiate between mothers' and fathers' nutrition knowledge, an association was found between parent (mostly mothers) nutrition knowledge and a lower prevalence of child overweight (Variyam, 2001).

Nutrition knowledge research including fathers is scarce, however research specifically targeting men has increased in recent years. Historically, most research targeting men has been predominantly limited to athletes (Spronk et al., 2014). A systematic review which evaluated nutrition knowledge among athletes concluded the sex of the athlete did not predict nutrition knowledge (Trakman et al., 2016). A 2020 study of Ethiopian families evaluated the influence of fathers' dietary knowledge on the dietary intakes of the household (Ambikapathi et al., 2021). The researchers concluded higher father vitamin and dietary knowledge was associated with greater diversity of dietary intake among the women and children in the household (Ambikapathi et al., 2021). These associations were significant ($p < 0.05$) and determined to have additive associations with household dietary diversity after controlling for household income and women's education and nutrition knowledge (Ambikapathi et al., 2021).

Parents' healthy eating has been shown to encourage children's healthy eating and associated with healthier child weight status (Variyam, 2001). As described herein, parent dietary patterns are impacted by multiple factors which impact food selection and dietary intake, including nutrition knowledge. Thus, I will investigate the moderating effect of fathers' healthy eating, or dietary pattern, on the association between nutrition knowledge and child weight status. I believe the positive association between a healthier father dietary pattern and decreases in child BMI percentile will be stronger for fathers with greater nutrition knowledge.

Food Security

Food security includes reliable access to nutritious and sufficient amounts of food whereas food insecurity includes limited or uncertain access to nutritious and sufficient amounts of food (Leung & Tester, 2019). An understanding of the food security status of the household is important when assessing dietary intake (Hanson & Connor, 2014). Food insecurity has been linked to women's decreased fruits and vegetables intake, but a limited number of studies include men (Hanson & Connor, 2014).

Several determinants have been linked to childhood obesity including food insecurity, socioeconomic status, ethnicity, and ecological environments including family and school (Kaur et al., 2015). Analysis of 2001-2010 NHANES data for children found a significant association between obesity and food insecurity for children aged 6-11 years (OR: 1.81; 95% CI: 1.33 - 2.48) (Leung & Tester, 2019). In 2017, the prevalence of U.S. household food insecurity was 11.8% and was found to disproportionately impact minoritized populations and families (Leung & Tester, 2019). The 2018-2020 prevalence of U.S. household food insecurity has slightly declined to 10.7% (USDA, 2021). The 2018-2020 prevalence of U.S. household very low food security (4.1%) has significantly declined since 2018 (4.3%) (USDA, 2021).

The prevalence of food insecurity is higher in the south region of the U.S., including North Carolina (NC) (Leung & Tester, 2019). The 2018-2020 prevalence of food insecurity among NC households was 12.1% (USDA, 2021). The prevalence of very low food security among NC households was 3.7% (USDA, 2021).

Covid-19 Pandemic

At the time of this research, the novel Coronavirus disease 2019 (COVID-19) global pandemic resulted in fundamental changes to families' everyday lives. The Center for … declared that Covid-19 was a pandemic on March 11, 2020. On March 13, 2020, the U.S. government imposed social distancing mandates to decrease the spread of COVID-19. Social distancing mandates resulted in impacts to employment, income, education, childcare, and community resources for many families (Adams et al., 2020). Recent cross-sectional research suggests COVID-19 mitigation strategies have impacted the home food environment, families' food security, and parent feeding practices (Adams et al., 2020).

For many families, adherence to social distancing guidelines decreased the frequency of grocery shopping and impacted the availability and types of foods in the home. Thus, many families decreased purchases of fresh foods, such as fruits and vegetables, and increased purchases of non-perishable, processed, and calorie-dense foods (Adams et al., 2020). However, more families reported decreased consumption of take-out and restaurant meals and a significant increase in home-cooked meals (Adams et al., 2020). Because school-aged children are spending most, if not all their time at home, the foods available in the home potentially have a greater impact on their dietary intake than prior to COVID-19 restrictions (Adams et al., 2020).

Early research into the effects of the COVID-19 pandemic have highlighted the significant increase in very low food insecurity, especially among lower-income families (Adams

et al., 2020). Also of concern is the increase in parent-report of controlling and restrictive food parenting practices attributed to increased stress, anxiety, and food insecurity (Adams et al., 2020). Decreased structure and routine in the home have also contributed to shifts in meal patterns and frequency of meals (Adams et al., 2020).

Given the potential COVID-19 pandemic impacts to participant families, additional measures were added to the online survey. The added measures are described in further detail in the online father survey measures section of this manuscript.

From the relevant literature, it can be established parent feeding styles, food-parenting practices, and nutrition knowledge are factors associated with child weight outcomes. Recognition of the unique contributions of fathers to these factors has increased interest in engaging fathers in family-based obesity prevention research among researchers, community stakeholders, and health professionals (Peeters et al., 2019). The inclusion of fathers who are representative of diverse ethnic and racial populations, varied socioeconomic backgrounds, and family structures is critical to best examine the role of fathers in child feeding and weight-related behaviors (Peeters et al., 2019). Further, as children are nested in a family household, it is important to utilize a theoretical framework, such as the Ecological Systems Theory, to examine the various factors which influence child weight status outcomes.

Theoretical Framework

The causes of childhood obesity are multifactorial. Examination of risk factors and predictors of childhood obesity must take into consideration the child, family, community, and societal characteristics and niches in which the child is embedded (Davison & Birch, 2001). Thus, this study is grounded in Bronfenbrenner's Ecological Systems Theory (EST) which posits children’s biology and behaviors are shaped by multiple factors in their environment

(Bronfenbrenner & Evans, 2000). In the case of school-aged children, the ecological niches in which they are embedded typically include family, school, community, and society (Davison & Birch, 2001). Child characteristics might include age and sex; family characteristics might include parent child feeding styles and practices, parent weight status, and nutrition knowledge; and community and society characteristics might include ethnicity, SES, and neighborhood safety (Davison & Birch, 2001). However, it is important to distinguish that this study does not contemplate the effect of time or the bidirectional aspects of the parent-child relationship, both central in Bronfenbrenner's theory (Tudge et al., 2009).

Ecological Systems Theory provides a framework to examine child's weight status in relation to the interaction among child, family, and community/demographic factors (Davison & Birch, 2001). EST provides a useful framework to identify areas that are salient for promoting a healthy family environment. For example, Park et al. examined child, parent, and community factors associated with preschool child BMI z-scores (Park et al., 2019). They found a significant association between a higher child BMI z-score and higher household income (β = 0.274, p = 0.024) (Park et al., 2019). Another study examined school-aged Hispanic children using the EST lens and found parent BMI was the strongest predictor of unhealthy child BMI (Adj R^2 = 0.12) (Elder et al., 2010). However, both studies indicated inclusion of father-specific factors, such as feeding practices, are needed to better understand contributions to child weight status.

Significance

A significant amount of childhood obesity prevention family-based research has advanced the field, but most have been maternal-centric, even if delivered as a family-based program (Fraser et al., 2011). Research confirms fathers' increased participation in food and

meal responsibilities including grocery shopping, meal preparation, and determining child portion sizes (Khandpur et al., 2016). Yet a recent review found that only 17% of parent participants in > 600 studies on parenting and childhood obesity included fathers (Davison et al., 2018). Thus, current research falls short of providing insight into the factors and influences of fathers on child weight outcomes needed to develop and implement effective childhood obesity prevention interventions. Additionally, most father research includes white fathers with higher education and income, with low representation of Hispanic, AA, and lower education and income fathers who are at higher risk for obesity (Davison et al., 2016; Fraser et al., 2011). This study was designed to include fathers from traditional and nontraditional family structures, racially and ethnically diverse backgrounds, and varied socioeconomic positions.

The insights from this research may contribute to future development of family-based childhood obesity prevention interventions and provide important insights for practitioners. Currently, family-based interventions are likely based on maternal data which may limit program efficacy and father participation (Davison et al., 2016). If the hypotheses of this study are supported, it would potentially contribute to greater efficacy of family-based interventions as father-specific attributes could be integrated. The participation of multiple family members in child health programs has been shown to increase program efficacy (Davison et al., 2016). As well, this research may contribute to the development of tailored, father-focused childhood obesity prevention education and interventions to mitigate unhealthy child weight outcomes. The results will also provide healthcare professionals with insights into father-specific feeding styles, behaviors and insight into how to tailor childhood obesity interventions to groups with higher prevalence rates, which may help reduce disparities among minoritized and low-income households.

Innovation

Interest in engaging fathers in family-based obesity prevention research is increasing among researchers, community stakeholders, and health professionals (Peeters et al., 2019). The inclusion of fathers who are representative of diverse ethnic and racial populations, varied socioeconomic backgrounds, and family structures is critical to best analyze the role of fathers in child feeding and weight-related behaviors (Peeters et al., 2019). Additionally, distinction of father food parenting styles from father food parenting practices is innovative as most research capturing this distinction has been limited to mothers (Vaughn et al., 2016). Recruiting fathers directly, rather than through the mother, is a novel approach designed to minimize attrition and engage with fathers directly (Peeters et al., 2019; Stahlschmidt et al., 2013). This study employed recruitment strategies specifically tailored to engage fathers with diverse racial, ethnic, and socioeconomic backgrounds who parent a child aged 6 -11 years. Further, the use of recruitment venues identified as credible by fathers, such as worksites and trusted community partners, also increased the likelihood of an adequate study population (Davison et al., 2017). The use of the EST framework, although not unique to childhood prevention research, is an innovative approach to explore fathers' food parenting styles, practices, and nutrition knowledge and the associations with child weight outcomes.

Overview of Included Research

A cross-sectional study was conducted to address these specific aims and establish a foundation for further research. The study was conducted in two phases: online survey and an online father diet assessment. Fathers (n = 407) were recruited from multiple sites to participate in a content and face-validated online survey. Quantitative data regarding fathers' food-related parenting practices, nutrition knowledge, sociodemographic characteristics, food security status,

height and weight of themselves and a referent child, and participation in planning, shopping, and preparing food for their child was collected. Quantitative data related to impacts attributed to the COVID-19 pandemic was also be collected. At the end of the survey, fathers were prompted to provide their contact information to opt in for participation in the second phases of the study. Interested fathers were contacted by email to schedule participation in the second phase of the study. The second phase, father diet assessment, assessed the fathers' diet quality (*n* = 51). Dietary intake was captured and coded via the web-based 2020 Automated Self-Administered 24-h Assessment Tool (ASA24-2020).

CHAPTER II: PHASE 2: FATHER NUTRITION KNOWLEDGE AND FOOD-PARENTING PRACTICES ASSOCIATION WITH CHILD BMI PERCENTILE

Introduction

Childhood overweight and obesity trends continue to be of concern with 1 in 5 U.S. children and adolescents classified as obese (CDC, 2021). Obese children are at higher risk of obesity persisting into adulthood with short and long-term health complications. As children, many develop illnesses, such as hypertension and type 2 diabetes, and experience psychological impacts, such as depression, anxiety, bullying, and stigma (CDC, 2021). Obese children, with obesity persisting into adulthood, are at higher risk for serious health consequences as adults which can include heart disease, type 2 diabetes, and cancer (CDC, 2019c). The factors contributing to childhood overweight and obesity are multifactorial and include family, home, and child-specific characteristics.

The family and home environment of school-aged children play an important role in shaping children's eating patterns. Parents are usually the gatekeepers of foods in the home with food availability impacted by such factors as parent preference, convenience, cost, and nutrition knowledge (Shloim et al., 2015; Spronk et al., 2014). Additionally, parents play an important role in shaping the child's eating habits through their parent food-parenting practices, i.e., goal-directed feeding practices (Vaughn et al., 2016).

Food-parenting practices included the intentional and unintentional behaviors parents employ when feeding their child (Vaughn et al., 2016). Several cross-sectional studies have concluded that facilitating child regulation of food intake and promotion of child autonomy are associated with a healthy child weight, whereas parents coercive control strategies are associated

with child weight problems (Khandpur et al., 2014; Vaughn et al., 2016). Child-centered food-parenting practices, such as establishing rules and structure around mealtime, encouraging child selection of foods and perceived responsibility for child feeding, foster child self-regulation of satiety and appetite (Khandpur et al., 2014). In contrast, parent-centered food-parenting practices, such as pressuring a child to eat types or quantities of foods, potentially undermine the child's ability to regulate their appetite and increase the risk of obesity (Khandpur et al., 2014).

Parent-centered food-parenting practices, such as the use of restriction and pressure to eat, are subconstructs of the food-parenting practice construct of coercive control (Vaughn et al., 2016). Coercive control is a parent-centered food-parenting practice which imposes the will of the parent on the child to behave as desired (Vaughn et al., 2016). Coercive control food-parenting practices includes behaviors such as pressuring the child to "eat everything on their plate" or restricting the child's access to foods, such as cookies and candy. Coercive control food-parenting practices and authoritarian parent feeding styles have been linked to poor child self-regulation, increased food intake, and child overweight outcomes (Hubbs-Tait et al., 2008).

Parent nutrition knowledge may also play a role in the provision of adequate and nutritious meals for their children (Variyam, 2001). Knowledge of key nutrition concepts improve dietary selection related to food shopping, meal planning, and meal preparation. A 2014 systematic review evaluated the association between nutrition knowledge and dietary intake of adults $\geq$ 18 years old (Spronk et al., 2014). Greater nutrition knowledge was positively associated with higher intake of fruits and vegetables and lower amounts of unhealthy fats (Spronk et al., 2014). Further, higher parent nutrition knowledge has been correlated with healthier child weight outcomes (Variyam, 2001). The USDA assessed the nutrition knowledge of parents with children 6-17 years old via the Diet and Health Knowledge Survey (Variyam,

2001). Although the study did not differentiate between mothers' and fathers' nutrition knowledge, an association was found between parent (mostly mothers) nutrition knowledge and a lower prevalence of child overweight (Variyam, 2001).

Most of the evidence supporting the relationship between parent-feeding practices and nutrition knowledge in childhood obesity prevention research is based on mothers (Davison et al., 2016). An analysis of childhood obesity studies from 2009 to 2015 found 1% included only fathers, as compared to 36% which included only mothers (Davison et al., 2016). However, many fathers are increasingly participating in child-feeding activities due to increased maternal employment which has shifted traditional household structures for many families (Davison et al., 2016). Further, because most childhood obesity prevention interventions are planned and designed based on maternal factors, the content may not be as relevant for fathers. Health education programs targeting both parents have been shown to increase program efficacy (Davison et al., 2016). Thus, this study seeks to contribute to a better understanding of fathers' food-parenting practices and nutrition knowledge and the association with increases and decreases in child BMI percentile.

The aim of this study was to examine father food-parenting practices and nutrition knowledge as predictors of increases or decreases in the child BMI percentile. Three hypotheses were tested: 1. a higher father coercive control score, as described by the food-parenting practices of restriction and pressure to eat, would predict an increase in child BMI percentile, 2. father food-parenting practices, as described by higher perceived responsibility for child feeding, modeling of fruit and vegetable (FV) intake and promotion of child autonomy using praise, and less concern about child weight, would predict a decrease in child BMI percentile, and 3. higher father nutrition knowledge would predict a decrease in child BMI percentile.

This study occurred during the novel Coronavirus disease 2020 (COVID-19) global pandemic that resulted in fundamental changes to families' everyday lives. On March 13, 2020, the U.S. government imposed social distancing mandates to decrease the spread of COVID-19. Social distancing mandates impacted employment, delivery of education, and the home food environment (Adams et al., 2020). Recent cross-sectional research suggests COVID-19 mitigation strategies have impacted the home food environment, families' food security, and parent feeding practices (Adams et al., 2020). An understanding of the food security status of the household is important when assessing dietary intake (Hanson & Connor, 2014). Food insecurity has been linked to women's decreased fruits and vegetables intake, but a limited number of studies include men (Hanson & Connor, 2014). Given the potential COVID-19 pandemic impacts to the participant fathers, additional measures were added to the study to capture the potential impacts on fathers, impacts to food security, and changes to meal patterns and involvement of fathers in meals with their children.

Methods

The following procedures were approved by the UNCG and Cone Health Institutional Review Boards. Fathers who completed the online survey received a $10 online Amazon gift card.

Participants

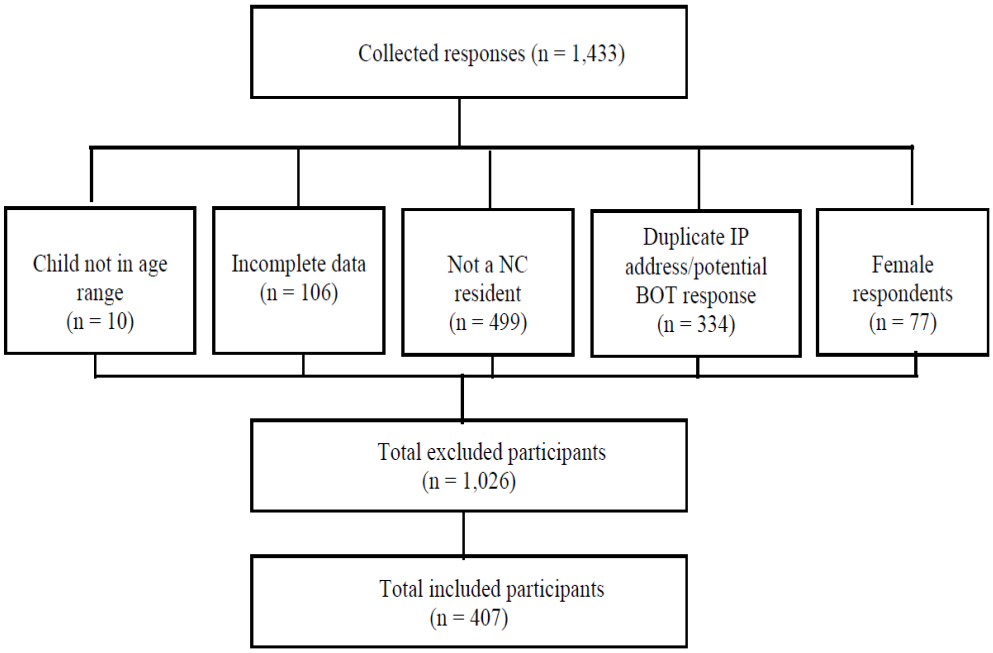
North Carolina fathers were recruited to participate in an online survey using purposive email and snowball sampling techniques. Eligibility criteria included: North Carolina resident; father age at least 18 years; at least one child between 6 and 11 years old; ate at least one meal per week with the child; ability to speak and read English.

To support the recruitment of a diverse sample of fathers, a healthcare organization located in central North Carolina supported an email employee recruitment campaign at six central North Carolina hospital sites and associated physician practices. Due to the COVID-19 pandemic, two planned recruitment sites, Guilford County Head Start and Guilford County 4-H were unavailable as recruitment sites due to limited operations and staffing. The recruitment of UNCG male staff and graduate students were added as an approved recruitment venue. Eligible participants from the two organizations were contacted via an email listserv provided by the UNCG Office of Research and of the healthcare organization. Using worksites and trusted community partners to recruit and increase father participation in research has been identified in the literature as a successful strategy for recruiting fathers (Davison et al., 2017).

The 6-11 child age group was chosen as pubertal changes have not yet occurred for most of the children and an unhealthy weight status at this age has been shown to persist into adolescence and adulthood (Whitaker et al., 1997). An understanding of environmental risk factors is important to identify at this age because parents and practitioners can still employ positive diet and lifestyle changes to decrease excess adiposity (Whitaker et al., 1997).

A total of 1,433 survey responses were collected. Of those, 1,026 surveys were excluded. As shown in Figure 1, participant survey responses were excluded due to incomplete data, suspected BOT activity, and the respondent was not a NC resident, was female, and/or did not have a child aged 6-11 years. The final sample included 407 father-child dyads.

Figure 1: Flowchart of recruited participants.



Survey Design and Variables

Participants received a Qualtrics survey link to an online consent form. The consent for participation in the online survey is listed in Appendix A. The survey was loaded for those participants who selected "I agree to participate." At the end of the survey, participants were requested to record their email address to confirm completion of the survey and to trigger processing of the $10 incentive. Participants were also provided the opportunity to "opt in" for participation in the second phase of the study: the father diet assessment.

The survey included 101 questions to collect father, child, and household demographic characteristics. The survey questions and scales are listed in Appendix B. A modified survey was provided to the healthcare organization employees. The modified survey included two additional questions to enable identification of participant work location and department. The two additional questions are listed in Appendix C.

The survey measures were composed of pre-existing measures with established reliability

and validity. Table 1 provides a description of all variables. Following Table 1 is a detailed description of all measures and control variables.

Table 1: Table of variables: type, measurement and range of scores

Variable	Type	Measurement	Range
Dependent variable			
Child BMI percentile	Continuous	CDC BMI-for age percentile macro	3rd – 97th percentile
Predictor variables			
Coercive control	Derived continuous	Child Feeding Questionnaire 5-point Likert scale	9 items 0 - 45
Perceived responsibility for child feeding	Derived continuous	Child Feeding Questionnaire 5-point Likert scale	7 items 0 - 35
Modeling fruit and vegetable intake	Derived continuous	Food record scale (Cullen, 2001) 4-point Likert scale	11 items 0 - 44
Promotion of child autonomy using praise	Continuous	Alabama Parenting Questionnaire - Short Form 5-point Likert scale	1 item 0 - 5
Concern about child weight	Derived continuous	Child Feeding Questionnaire 3-point Likert scale	2 items 0 - 6
Nutrition knowledge	Derived continuous	General Nutrition Knowledge Questionnaire Multiple choice, true/false	18 items 0 - 18
Sociodemographic characteristics			
Race	Categorical	White, Black or African American, American Indian or Alaska Native, Asian, Native Hawaiian Pacific Islander or Other	
Ethnicity	Categorical	Hispanic or Latino, Non-Hispanic or Non-Latino	
Level of education	Categorical	High school or less, Some college, Vocational, Associate degree, Bachelor's degree, Graduate or doctoral	

Variable	Type	Measurement	Range
Income	Categorical	<$15k, $15k-24,999k, $25k-34,999k, $35k-49,999k, $50K-74,999k, >$75k	
Sex of child	Categorical	Male or Female	

1. American Community Survey - North Carolina. 2019 (https://www.census.gov/acs/www/data/data-tables-and-tools/data-profiles/)
2. Missing 1 value (n=406)
3. ACS2019-NC - % male population
4. 2018 WIC coverage by state. 2018 WIC Coverage Rates by State, Race, and Hispanic/Latino Ethnicity (usda.gov)
5. Children living in households receiving SNAP: American Community Survey – North Carolina. Table S0901. 2019 (Census - Table Results).
6. Prevalence of household-level food insecurity and very low food insecurity by state 2018-2020. Economic Research Service. (mapdata2020.xlsx (live.com)).

Dependent Variable

Child BMI Percentile

Fathers were asked to access their child's most recent medical provider reported, patient-portal child measurements of height (feet, inch) and weight (pound) measurements. Collected measurements were converted to meters (height) and kilograms (weight). Medical provider reported, patient portal-reported child height and weight data was used to compute the child's BMI (kg/m2) values using the age and sex CDC growth chart guidelines to define BMI percentile (CDC, 2019a). The child BMI percentile variable was derived using the SAS macro produced by the Centers for Disease Control and Prevention (CDC-DNPAO, 2019).

The child BMI percentile variable was a continuous variable. For purposes of interpretation, the BMI-for-age percentile categories are defined as follows: underweight (< 5^{th} percentile); healthy weight (5^{th} to < 85^{th} percentile); overweight (85^{th} to < 95^{th} percentile); obese

($\geq$ 95th percentile) (CDC, 2019a). A higher child BMI percentile indicated a higher child BMI value.

Derived Predictor Variables

Father Coercive Control Score

The father coercive control score was a derived, continuous variable. The coercive control score measured the parent-centered food-parenting practices of restriction and pressure to eat (Vaughn et al., 2016). The coercive control score was derived from nine questions adapted from the CFQ (Birch et al., 2001).

The coercive control score was derived from the summed score of two subscales: 1. restriction (6-questions) and 2. pressure to eat (3-questions). The subscale of restriction measured the extent fathers restricted their child's access to food(s). The subscale of pressure to eat measured fathers' tendency to pressure their child to eat. Questions measuring pressure to eat and restriction used a 5-point Likert scale (disagree-agree). Question responses were summed and resulted in a possible score of 0 - 45. A higher score indicated a higher utilization of father coercive control child-feeding practices.

Father Food-Parenting Practices

Four father food-parenting practices were examined in this study: 1. perceived responsibility for child feeding, 2. modeling fruit and vegetable (FV) intake, 3. promotion of child autonomy using praise, and 4. concern about child weight. A derived variable was created for each food-parenting practice: perceived responsibility (3-questions); modeling FV intake (11-questions); promotion of child autonomy (1-question); concern about child weight (2-questions).

The variable perceived responsibility for child feeding was adapted from the Child Feeding Questionnaire (CFQ). The CFQ measures parent beliefs, attitudes, and practices related to child feeding and obesity proneness and has been validated with parents of children aged 2-11 years (Birch et al., 2001). The subscale of perceived responsibility measured fathers' perception of their responsibility for child feeding. Questions measuring perceived responsibility were measured on a 5-point Likert scale (mostly or always my spouse/partner – mostly or always me; never-always). A continuous variable for perceived responsibility for child feeding (0 – 35) was derived using the mean score. A higher perceived responsibility score indicated a higher father perceived responsibility for child food-parenting.

The father modeling FV intake variable was adapted from a study which measured family and peer influences on children's fruit, juice, and vegetable consumption, i.e. the food record scale (Cullen et al., 2001). The subscale of father modeling FV intake measured the frequency of fruit (all meals) and vegetable (lunch, dinner, snack) consumption during meals (breakfast, lunch, dinner, snack) with their child. The construct of parent modeling fruit and vegetable intake includes the intentional effort of the parent to actively demonstrate consumption of fruits and vegetables during meals and snacks with their child (Vaughn et al., 2016). Questions measuring modeling FV intake used a 5-point Likert scale (never (0 days) – always (7days)). A continuous variable for modeling FV intake (0 – 44) was derived using the mean score. A higher modeling FV score indicated a higher frequency of fathers' eating (i.e., modeling) fruits and vegetables during meals and snacks with their child.

The promotion of child autonomy using praise variable was adapted from the Alabama Parenting Questionnaire - Short Form (APQ-9) (Elgar et al., 2007). The APQ-9 measures five dimensions of parenting related to the etiology and treatment of child externalizing problems,

including the use of positive discipline techniques, i.e., the use of praise (Elgar et al., 2007). The subscale of father promotion of child autonomy using praise measured fathers' verbal, positive reinforcement provided to their child. The question measuring promotion of child autonomy using praise used a 5-point Likert scale (never – always). A continuous variable for the promotion of child autonomy using praise (0 - 5) was derived using the mean score. A higher score indicated higher father reinforcement of child autonomy using praise.

The concern about child weight variable was adapted from the CFQ. The CFQ measures parent beliefs, attitudes, and practices related to child feeding and obesity proneness and has been validated with parents of children aged 2-11 years (Birch et al., 2001). The subscale of concern about their child's weight measured fathers' concerns about their child's weight. Questions measuring concern about child weight used a 3-point Likert scale (unconcerned-concerned). A continuous variable for the concern about child weight (0 – 6) was derived using the mean score. A higher score indicated greater father concern about child weight.

Father Nutrition Knowledge Score

Fathers' nutrition knowledge was a continuous predictor variable. A total of 18 questions assessed four areas of fathers' nutrition knowledge: 1. knowledge of dietary recommendations, 2. sources of nutrients, 3. everyday food choices, and 4. diet-disease relationships. Questions were taken from the recently revised General Nutrition Knowledge Questionnaire (GNKQ-R), developed for UK adults (Kliemann et al., 2016). The internal consistency of each section was acceptable (Cronbach's alpha = 0.70 ± 0.97), reliability was above 0.7, and demonstrated adequate construct and convergent validity (Kliemann et al., 2016).

Father responses to each question was scored as 1 point if correct and 0 if incorrect. The summed score resulted in a possible score of 0 - 18. A higher nutrition knowledge score indicated higher nutrition knowledge.

Additional Descriptive Variables

COVID-19 Impact Measures

The potential impacts to fathers and their families attributed to the COVID-19 pandemic were measured using questions adapted from the Canadian Community Health Survey – Mental Health module, Conger's measures of economic pressure, and the Stressful Life Events questionnaire (Barrera & Caples, 2001; Conger et al., 1994; Cutrona & Russell, 1987). Twenty-four additional questions were added to capture these impacts. These additional questions address the following topics: 1. changes in employment, 2. mode of child education, 3. changes in food security status, 4. changes to family meal patterns, and 5. measures of stress. Changes to food availability in the household were also captured via 5-items.

Household Food Security

Household food security was measured utilizing the 6-item USDA U.S. Adult Food Security Survey Module (Economic Research Service, 2019b). The use of the 6-item measurement reduces participant burden and provides high specificity and sensitivity and minimal bias compared to the 18-item measure (Economic Research Service, 2019a). Responses to the 6-items were summed according to the guidelines provided for summing 6-item scores. Food security status was based on the USDA categorization and indicated scoring: high or marginal food security (score: 0 – 1); low food security (score: 2 - 4); and very low food security (score: 5 - 6).

Demographic and Other Control Variables

Sociodemographic variables were collected via father self-report. Child age, sex, and the child's health system patient portal-reported height and weight were collected. Father race, ethnicity, level of education, income, age, height and weight were collected.

Data Analysis

All analyses were conducted in SAS (version 9.4, SAS Institute Inc., Cary, NC, 2008). To determine statistical significance, $p < .05$ was used for all analyses. Descriptive statistics and multiple regression analyses examined if children's weight status was predicted by father coercive control feeding practices, father food-parenting practices (perceived responsibility for child feeding, modeling FV intake, promotion of child autonomy using praise, and concern about child weight) and nutrition knowledge.

A multiple regression model investigated the specific aim (specific aim 1) and the associated hypotheses. One model was utilized to investigate the association between child BMI weight percentile and fathers' coercive control feeding practices, four father food-parenting practices (i.e., perceived responsibility for child feeding; modeling fruit and vegetable intake; promotion of child autonomy using praise; concern about child weight), and father nutrition knowledge.

For purposes of analysis, race, income, and education categories were collapsed due to low sample size. Ethnicity was unchanged: non-Hispanic or Hispanic. Race was collapsed into three categories: 1.white, 2. black, and 3. other (Asian, Native American, Alaska Native, Native Hawaiian, Pacific Islander, multi-racial). Household income was collapsed into four categories: 1. < $35k; 2. $35 – 50k; 3. $50k – $75k; and 4. $75k +. Education categories were collapsed

into four categories: 1. high school or less, 2. some college, vocational school, associate degree, 3. bachelor's degree, and 4. graduate degree.

The multiple regression model was created using the general linear models (PROC GLM) procedure in SAS (SAS/STAT, 2016). Socio-demographic categorial variables were automatically dummy-coded using the class option (Pasta, 2005). The reference category for each socio-demographic category was as follows: ethnicity = non-Hispanic; race = white; household income = > $75k; education = graduate degree.

Using the class option, dummy variables were created for each socio-demographic category (Pasta, 2005). Two dummy variables for race were created: 1. race = black (yes or no) and 2. race = other (yes or no). Therefore, race = white corresponded to the reference in the instance where race, black = 0 and race, other = 0. In similar fashion, three dummy variables for household income were created: 1. household income < $35k (yes or no); 2. household income = $35 – 50k (yes or no); 3. household income = $50k – $75k (yes or no), with reference category = > $75k. Finally, three dummy variables for education were created: 1. Education = high school or less (yes or no); 2. Education = some college, vocational school, associate degree (yes or no); 3. Education = bachelor's degree (yes or no), with reference category = graduate degree.

Power Analysis

In cross-sectional research, the average effect size for the association between fathers' diet quality and child weight outcomes was 0.39 (Vollmer et al., 2015). Thus, 210 father-child dyads were determined to be an adequate sample size to test all aims at a minimum level of 0.80 power with a medium effect size (0.39) and a 0.05 α level. To account for possible attrition, the sample size was adjusted by ~20% (40) with the goal of at least 250 father-child participants.

Results

Descriptive Statistics

In total, 407 father-child dyads completed the survey. The race and ethnicity distribution of the father-child dyads (*n* = 407) was 82% white and one-third Hispanic. The average age of the fathers was 36.41 (SD = 5.04) years old, and the average age of the referent child was 8.44 (SD = 1.46) years old. The referent child sex was 68.6% male (*n* = 279) and 31.4% female (*n* = 128). A full description of participant demographic characteristics is shown in Table 2.

Table 2: Participant demographic characteristics (*n* = 407)

Demographic Category	Number of participants	%	% NC[1] (2019)
Race			
White	332	81.6%	68.1%
Black Americans	55	13.5%	21.5%
Native American or Alaskan native	6	1.5%	1.2%
Asian	5	1.2%	3.0%
Hawaiian or Pacific Islander	1	0.2%	0.1%
Two or more races	8	2.0%	2.8%
Ethnicity[2]			
Not Hispanic or Latino	271	66.7%	90.2%
Hispanic or Latino	135	33.3%	9.8%
Education[3]			
High school or less	40	9.8%	40.2%
Vocational school	46	11.3%	
Some college	91	22.4%	20.2%
Associate Degree	50	12.3%	8.7%
Bachelor's Degree	126	31.0%	19.8%
Graduate Degree	54	13.3%	11.1%
Income			
Less than $15,000	6	1.5%	10.8%
$15,000 to $24,999	44	10.8%	9.6%
$25,000 to $34,999	58	14.3%	9.7%
$35,000 to $49,999	92	22.6%	13.8%
$50,000 - $74,999	106	26.0%	18.0%

Demographic Category	Number of participants	%	% NC[1] (2019)
more than $75,000	101	24.8%	38.0%
Household characteristics			
WIC[4]	171	42.1%	56.6%
SNAP[5]	180	44.3%	24.5%
Household food security[6]			
High or marginal food security	251	61.7%	84.2%
Low food security	86	21.1%	12.1%
Very low food security	70	17.2%	3.7%

1. American Community Survey - North Carolina. 2019 (https://www.census.gov/acs/www/data/data-tables-and-tools/data-profiles/)
2. Missing 1 value (n=406)
3. ACS2019-NC - % male population
4. 2018 WIC coverage by state. 2018 WIC Coverage Rates by State, Race, and Hispanic/Latino Ethnicity (usda.gov)
5. Children living in households receiving SNAP: American Community Survey – North Carolina. Table S0901. 2019 (Census - Table Results).
6. Prevalence of household-level food insecurity and very low food insecurity by state 2018-2020. Economic Research Service. (mapdata2020.xlsx (live.com)).

Many fathers were college-educated with 44% having a bachelor's degree or higher. Father household annual income was variable, with 51% of participants earning $50k or more annually. Supplementary Nutrition Assistance Program (SNAP) assistance was received by 44% of participants and 42% indicated receiving benefits from the Women, Infants, and Children (WIC) program. Current federal guidelines for SNAP and WIC are < 130% and 185%, respectively, of the federal income poverty guidelines. According to the 2019 North Carolina American Community Survey (ACS), approximately 20% of families with children under age 18 have an income level below the national poverty threshold (American Community Survey, 2020).

Race and ethnicity distribution in NC according to the 2019 NC ACS were white (68%), black (22%), and Hispanic (10%) (U.S. Census Bureau, 2020). Because many participants may have resided in Guilford County, NC, the 2019 Guilford County race and ethnicity distributions

were also important to consider: white (47%), black (33%), Hispanic (10%) (U.S. Census Bureau, 2020). As overweight and obesity disproportionately affects minoritized children, an effort was made to over-sample black and Hispanic families. However, black fathers were under-represented (13.5%) as compared to 22% of the NC black population distribution. Hispanic fathers were oversampled with 33% of the participant population identified as Hispanic as compared to the NC Hispanic distribution of 9.8%.

Child Weight Status

Child body mass index (BMI) was computed for children with complete height and weight records (n = 404). The CDC macro for SAS for BMI-for age was used to categorize each child according to the corresponding child weight status category (CDC-DNPAO, 2019). The child BMI-for-age weight status categories are as follows: underweight (< 5th percentile); healthy weight (5th to < 85th percentile); overweight (85th to < 95th percentile); obese ($\geq$ 95th percentile). Of the 404 children, 47% (n = 190) were categorized as overweight (n = 93) or obese (n = 97). The distribution of child weight status in the study population is shown in Table 3.

Table 3: Distribution of child weight status (n = 404).

Child BMI category	Number of Children[1]	Percent
Underweight	42	10.4%
Healthy weight	172	42.6%
Overweight	93	23.0%
Obese	97	24.0%

1. 3 incomplete records (n = 404)

Father Weight Status

Father BMI was computed for fathers with complete self-reported height and weight records (n = 407). Father weight status was calculated according to the CDC adult BMI

categories: underweight (< 18.5); healthy weight (18.5 to < 25); overweight (25 to < 30); obese (≥ 30) (CDC, 2021). The distribution of father weight status is shown in Table 4.

Table 4: Distribution of father weight status (*n* = 407).

Adult BMI category	Number of fathers	Percent
Underweight	42	10.3 %
Healthy weight	186	45.7 %
Overweight	114	28.0 %
Obese	65	16.0 %

Bivariate and Internal Reliability Analyses

Before proceeding with the multiple regression analyses, Pearson's correlations were estimated to examine the bivariate associations among the main independent variables. The results are in Table 5. The correlation coefficients are indicated by **bold** type. The results indicated statistical evidence of a linear relationship between the main independent variables. The correlation matrix did not indicate any variables with a high correlation (i.e., all correlations < 0.8), thus abating concerns for multicollinearity. Thus, the multiple regression analyses included all main independent variables.

Table 5: Pearson's correlations: coercive control, nutrition knowledge, perceived responsibility for child feeding, concern about child weight, promotion of child autonomy using praise, modeling FV intake [Pearson's *r*; (*p*-value)].

	Coercive control	Nutrition knowledge	Perceived responsibility for child feeding	Concern about child weight	Promotion of child autonomy using praise	Modeling fruit and vegetable intake
Coercive control	**1.00000**	**-0.10153** (0.0406)	**0.13895** (0.0050)	**0.44665** (<.0001)	**0.07664** (0.1227)	**0.26520** (<.0001)

	Coercive control	Nutrition knowledge	Perceived responsibility for child feeding	Concern about child weight	Promotion of child autonomy using praise	Modeling fruit and vegetable intake
Nutrition knowledge	**-0.10153** (0.0406)	**1.00000**	**0.18550** (0.0002)	**-0.36308** (<.0001)	**0.10427** (0.0355)	**-0.31172** (<.0001)
Perceived responsibility for child feeding	**0.13895** (0.0050)	**0.18550** (0.0002	**1.00000**	**0.13037** (0.0085)	**0.08437** (0.0892)	**0.37286** (<.0001)
Concern about child weight	**0.44665** (<.0001)	**-0.36308** (<.0001)	**0.13037** (0.0085)	**1.00000**	**0.04126** (0.4064)	**0.30216** (<.0001)
Promotion of child autonomy using praise	**0.07664** (0.1227)	**0.10427** (0.0355)	**0.08437** (0.0892)	**0.04126** (0.4064)	**1.00000**	**0.14014** (0.0046)
Modeling fruit and vegetable intake	**0.26520** (<.0001)	**-0.31172** (<.0001)	**0.37286** (<.0001)	**0.30216** (<.0001)	**0.14014** (0.0046)	**1.00000**

Cronbach's alpha analyses was also calculated to assess the internal reliability for each scale. The internal consistency was adequate (Cronbach's alphas above 0.7) for all composited summary variables. The standardized mean factor scores (± SD) and internal reliability estimates (Cronbach's alphas) for the derived variables are presented in Table 6 for descriptive purposes.

Table 6: Internal reliability of study scales: nutrition knowledge, concern about child weight, perceived responsibility for child feeding, coercive control, modeling FV intake.

Study scale	Mean (SD)	Cronbach's alpha
Coercive control (9-items)	31.66 (6.70)	0.76
Nutrition knowledge (18-items)	8.81 (4.43)	0.83
Food-parenting practices		
Perceived responsibility for child feeding (3-items)	8.42 (3.25)	0.87
Modeling fruit and vegetable intake (11-items)	27.63 (7.44)	0.89
Promotion of child autonomy using praise (1-item)	4.11 (1.01)	
Concern about child weight (2-items)	4.08 (1.32)	0.83

Multiple Regression Model - Specific Aim and Hypotheses

The first aim of this study was to examine father food-parenting practices and nutrition knowledge as predictors of their child's weight status. Controlling for other variables in the multiple-predictor model, I hypothesized that: 1. a higher father coercive control score, as described by the food-parenting practices of restriction and pressure to eat, would predict an increase in child BMI percentile; 2. father food-parenting practices, as described by higher perceived responsibility for child feeding, modeling of fruit and vegetable (FV) intake and promotion of child autonomy using praise, and less concern about child weight, would predict a decrease in child BMI percentile; and 3. higher father nutrition knowledge would predict a decrease in child BMI percentile.

A multiple regression model was used to predict child BMI percentile from the predictor variables shown in Table 7. The overall model was significant and explained 21.5% of the variance in child BMI percentile (R= 0.2145; F = 7.05; $p < 0.0001$).

Table 7: Multiple regression predicting child BMI percentile from father food-parenting practices and nutrition knowledge.

Predictor	β*	B*	±SE	*p*-value
Coercive control	0.0989	0.5094	0.2710	0.0609
Nutrition knowledge	- 0.1855	-1.4433	0.5263	0.0064
Perceived responsibility for child feeding	0.0736	0.7812	0.5588	0.1629
Modeling fruit and vegetable intake	- 0.0291	-0.1347	0.2648	0.6111
Promotion of child autonomy using praise	- 0.0600	-2.0476	1.5988	0.2011
Concern about child weight	0.2726	7.1148	1.4831	< 0.0001
Covariates				
Race				< 0.0010
Black	0.3865		0.1399	0.0060
Other	0.6007		0.2145	0.0054
Ethnicity				< 0.0001
Hispanic	-0.5155		0.1135	<.0001
Education				0.0062
High school or less	-0.4079		0.2255	0.0712
Some college, vocational school, associate degree	-0.4406		0.1809	0.0153
Bachelor's degree	-0.0586		0.1797	0.7447
Income				0.0260
< $35k	0.2642		0.1596	0.0985
$35k - $50k	0.3737		0.1519	0.0144
$50k - $75k	0.0286		0.1439	0.8425

*β is the standardized and B is the unstandardized regression coefficient.
Covariates: race (white (ref), black, other); ethnicity (Hispanic, non-Hispanic(ref)); father education (high school, vocational school, some college, associate degree, bachelor's degree, graduate degree or higher (ref)); household income (< $35k, $35-$50k, $50k-$75k, > $75k (ref)).

Hypothesis 1

When controlling for all other variables, the fathers' coercive control score was not significantly related to child BMI percentiles (β = 0.0989; SE = 0.5094; p = 0.0609). Thus, in

this model, an authoritarian feeding style, described by coercive control feeding practices, did not predict an unhealthier child weight status.

Hypothesis 2

When controlling for all other variables in the model, father perceived responsibility for child feeding (β = 0.0736; SE = 0.5588; p = 0.1629), father modeling of fruit and vegetable intake (β = - 0.0291; SE = 0.2648; p = 0.6111), and promotion of child autonomy using praise (β = - 0.0600; SE = 1.5988; p = 0.2011) were not significantly related to child BMI percentile. However, father concern about child weight was significantly related to child BMI percentile (β = 0.2726; SE = 1.4831; $p < 0.0001$). In this study population, for every 1-point increase in the father concern about child weight score, child BMI percentile was predicted to increase by 0.2726 BMI percentiles.

Promotion of child autonomy using praise was measured by how often the father praised the child after doing something well. About 80% of fathers in this study indicated a higher promotion of child autonomy using praise. However, the results of this analysis were not significant.

Hypothesis 3

When controlling for all other variables, father nutrition knowledge was significantly related to child BMI percentile (β = - 0.1855; SE = 0.5263; p = 0.0064). Thus, in this model, a 1-point increase in the father nutrition knowledge score would be associated with a modest decrease in child BMI percentile of 0.1855, thus supporting the third hypothesis. The mean father nutrition knowledge score was 8.81 (SD = 4.43).

Additional Analyses

The multiple regression model also included sociodemographic covariates. Non-Hispanic, white, higher education (graduate school or higher) and household income (> $75k) fathers were the referent group in the analyses.

Race

When controlling for all other variables in the model, race was significantly related to child BMI percentile ($p = 0.0010$). As compared to white children, the average BMI percentile for black and other (Asian, Native American, Alaska Native, Native Hawaiian, Pacific Islander, multi-racial) race children were predicted to be slightly higher. For black children, the average BMI percentile was predicted to be 0.3865 BMI percentiles higher ($\beta = 0.3865$; SE = 0.1399; $p = 0.0060$). Similarly, for children in the other race category the average BMI percentile was predicted to be 0.6007 BMI percentiles higher as compared to white children ($\beta = 0.6007$; SE = 0.2145; $p = 0.0054$).

Ethnicity

When controlling for all other variables in the model, ethnicity was significantly related to child BMI percentile ($p < 0.0001$). As compared to non-Hispanic children, the average BMI percentile for Hispanic children was predicted to be 0.5155 BMI percentile percentage points lower ($\beta = -0.5155$; SE = 0.1135; $p < 0.0001$).

Education

When controlling for all other variables in the model, father education was significantly related to child BMI percentile ($p = 0.0062$). As compared to children of fathers with higher education (graduate degree or higher), the child BMI percentile was predicted to be lower for children of fathers with vocational school, some college or an associate degree ($\beta = -0.4406$; SE

= 0.1809; p = 0.0153). The other education categories, high school or less (p = 0.0712) and bachelor's degree (p = 0.7447) were not significantly related to child BMI percentile.

Income

When controlling for all other variables, household income was significantly related to child BMI percentile (p = 0.0260). As compared to higher income father households (> $75k), the child BMI percentile in households with income $35k to $50k was predicted to be higher (β = 0.3737; SE = 0.1519; p = 0.0144). The other household income levels, < $35k ($p$ = 0.0985) and $50 - $75k ($p$ = 0.8425) were not significantly related to child BMI percentile.

Household Food Security

Many father households had high or marginal food security (n = 251; 62%). However, 21% (n = 86) of father households reported low food security and 17% (n = 70) reported very low food security. This is much higher than the 2018-20 estimates of food insecurity prevalence of North Carolina households: 12.1% low food security and 3.7% very low food security (Economic Research Service, 2019a)

The COVID-19 pandemic may have contributed to the higher number of food insecure households reported in this population. To capture the potential impacts from the pandemic, participants completed 5-items relevant to the impacts to household food security since March 13, 2020. Results were slightly different with 58% reporting there was enough food in their household whereas 9% reported there was inadequate food in the household. The reasons for not having enough food were mainly attributed to the following: 1. not being able to afford food, 2. concerns about going to the store, and 3. lack of availability in stores. Free meals were received by 35% of participants with most provided by churches, food pantries, shelters, National School Lunch Program or other program aimed at children, family, neighbors, and friends.

COVID-19 Impact on Father Household

A high number of fathers (57%) reported a loss of income due to the COVID-19 pandemic. Of those who reported a loss of employment (n = 173), most reported this was attributed to furlough (19%), temporary closure of business (24%), and their employer went out of business due to the COVID-19 pandemic (15%). Almost two-thirds of fathers (63%) reported they worked from home whereas 33% reported they continued to work outside the home.

Additional questions assessed impacts to the fathers' households, family members, and childcare and the degree they were affected. A summary of participant perceptions about the impact of the COVID-19 pandemic on various areas of their life and household can be found in Appendix I.

Fathers were also asked how the household meal behaviors might have changed since the beginning of COVID-19 restrictions (March 13, 2020). About 40% of fathers indicated there had been some change in frequency of meals together, and father participation in meal preparation and food shopping activities. A summary of responses can be found in Appendix J.

Father Perceptions of Economic Needs and Social Support

Fathers were asked whether they believed they had sufficient economic resources to support various households needs. Details of fathers' perceptions of economic sufficiency can be found in Appendix K. Fathers were also asked about the perceived level of social support present in their life. Ten questions assessed their level of agreement with different levels of social support. Details about the questions and distribution of responses can be found in Appendix L.

Discussion

The first aim of this study was to examine father child food-parenting practices, and nutrition knowledge as predictors of their child's weight status. In this study sample, father coercive control feeding practices was not significantly related to an increase in child BMI percentile. Additionally, father perceived responsibility for child feeding, father modeling of fruit and vegetable intake, and promotion of child autonomy using praise did not predict a decrease in child BMI percentile. Thus, the first hypothesis regarding father coercive control food-parenting practices and three of the four father food-parenting practices in the second hypothesis were not supported.

The fourth father food-parenting practice, concern about child weight, was found to be significantly related to an estimated modest increase in child BMI percentile ($\beta = 0.2726$; SE = 1.4831; $p < 0.0001$). Father concern about child weight and the related effect on child weight outcomes has not been well studied, especially with fathers. A 2017 study with low-income mothers ($n = 30$) and fathers ($n = 30$) of children aged 2 – 10 years in the same household found no significant relationship between fathers' concern for current child weight and child BMI z-score (Vollmer & Mobley, 2017). A 2014 review of father feeding practices and the association with child weight outcomes concluded that greater father concern about child weight was associated with higher body mass index in 7 of 9 studies, but 2 of 9 studies found no significant association (Khandpur et al., 2014). The literature also suggests that measuring how the concern about child weight is operationalized is an important distinction to capture when evaluating the effect on child weight outcomes (Vaughn et al., 2016). For example, does the concern manifest as restrictive father behaviors, and if so, a distinction between parent motivation to promote health or control weight would need to be clearly measured (Vaughn et al., 2016).

Although the father food-parenting practice of perceived responsibility for child feeding was not significantly related to child BMI percentile, having a heightened perception and involvement in child health (i.e., feeding) is associated with appropriate rule-setting and child-centered feeding behaviors (Birch et al., 2001). In this study, about 24% (n = 97) of fathers indicated they shared child-feeding responsibility equally with their partner or spouse. Feeding responsibilities included food shopping, meal planning, and meal preparation. About 44% (n = 180) responded their partner or spouse was mostly responsible for child-feeding. About 18% (n = 75) indicated they were primarily responsible for child feeding responsibilities. This study included a high number of Hispanic participants which may have influenced this result. Previous research with Mexican-American fathers found that positive child feeding involvement was not significantly associated with child weight outcomes (Penilla et al., 2017). However, in a different study with a more heterogenous population, a higher perceived responsibility for child-feeding was associated with lower coercion behaviors (Vollmer & Mobley, 2013). Thus, with non-Hispanic fathers, a focus on higher perceived child-parenting responsibility may result in lower coercion behaviors and potentially reduce child unhealthy weight outcomes.

This study's findings illustrate the importance of identifying father food-parenting practices which may result in unhealthy child weight outcomes. Additionally, parental concern about child weight is complex and may differ based on cultural background, parent education and income, and the age and sex of the child and parent (Ek et al., 2016). Further exploration of father concern about child weight in future studies might explore differences by socioeconomic factors. Additionally, an understanding of whether father concern about child weight results in changes to father feeding behaviors would be beneficial for childhood obesity prevention.

The last hypothesis for aim 1 examined the association between father nutrition knowledge and child weight status. In this study population, higher average father nutrition knowledge scores (mean = 10.17; SD ± 4.43)) were associated with healthier child weight status as compared to the child weight categories of overweight (score = 8.29) and obese (score = 7.44). These results were consistent with the study hypothesis that higher nutrition knowledge would be associated with a decrease in child BMI percentile.

When controlling for all other variables in the multiple regression model, a negative significant association was found between father nutrition knowledge and child BMI percentile (β = - 0.1855; SE = 0.5263; p = 0.0064). In this study population, a 1-point increase in father nutrition knowledge corresponded to a modest decrease in child BMI percentile. Conversely, a decrease in father nutrition knowledge may result in a modest increase in child BMI percentile. For some children, modest increases in BMI percentile may ultimately result in an unhealthy weight status.

Interestingly, in this study population an increase in nutrition knowledge was correlated with a slight decrease in modeling FV intake. This is contrary to an expected positive correlation between higher nutrition knowledge and modeling FV intake, i.e., a diet with more fruit and vegetable intake. However, decisions about dietary intake, i.e., modeling FV intake, is complex and may be impacted by factors such as taste, convenience, and cost (Spronk et al., 2014). Additionally, a diet with higher fruit and vegetable intake may also depend on factors such as fruit and vegetable availability, self-efficacy in preparation of fruits and vegetables, and the motivation to follow a healthier diet pattern (Spronk et al., 2014). Few studies have investigated the relationship between nutrition knowledge and diet quality among adults, parents, and fathers

(Spronk et al., 2014). Parent modeling FV intake may increase the fruit and vegetable intake of their children and may result in a healthier diet pattern (Draxten et al., 2014).

Increasing father nutrition knowledge has important implications for improving child weight outcomes, especially for lower-income and racially diverse populations. A study examining the association between SES and nutrition knowledge among minoritized parents with obese children found significant associations between black race ($p = 0.02$), no college education ($p = 0.02$), and income < \$15k ($p = 0.03$) and a lower understanding of food's nutrient value (Cluss et al., 2013). Although the current study did not investigate whether nutrition knowledge moderated the association between race and child BMI percentile, black race ($p = 0.0060$) was significantly related to increases in child BMI percentile as compared to whites. As obesity disproportionately impacts black (22%) and Hispanic (26%) children as compared to non-Hispanic white children (14%), these study findings support further investigation of the role of nutrition knowledge among racially diverse fathers and child weight outcomes would be beneficial (CDC, 2019c). A better understanding of the role of nutrition knowledge, and the implications of SES attributes, may assist in the development of more effective family-based childhood obesity education programming.

Last, it is important to consider the potential role of the COVID-19 pandemic and the impacts on the home feeding environment, daily routines, and food availability. Recent research with U.S. parents ($n = 584$) found that 20% of families reported increased very low food security ($p < 0.01$) and 47% reported purchasing more nonperishable, processed foods (Adams et al., 2020). Parents in food-insecure households reported increased use of restriction and pressure to eat as compared to parents in food-secure households (Adams et al., 2020). The increases in the coercive parenting practices of the parents in the Adams et. al (2020) study was likely due to

increased stress, access to fewer resources, and reduced access to food. In this study population, coercive parenting practices were not significantly related to child BMI percentile, but as previously mentioned, about 40% of fathers indicated there had been some change in frequency of family meals eaten together. Another potential impact of the COVID-19 pandemic may have been related to food security. About 21% of this population reported low food security as compared to the NC state average of 12.1 % (Economic Research Service, 2019a). This higher rate of low food security may have been exacerbated by impacts to household income and access to food during the COVID-19 pandemic. A summary of participant perceptions about the impact of the COVID-19 pandemic on family mealtimes and various areas of their life and household can be found in Appendices I and J.

This study includes some strengths and limitations to consider when evaluating the evidence. A strength of this study was the successful recruitment of a larger, heterogenous father population. Previous studies have largely included mostly white, educated fathers. Although most fathers in this study were white and educated, there was variability in ethnicity and income. Another strength was the use of validated measures of father food-parenting practices and nutrition knowledge. Further, the unique effects of father predictors of child BMI percentile were evaluated. However, future research is needed to examine other father child-feeding practices, such as monitoring, which were not measured in this study. Last, measurements related to the effects of the COVID-19 were captured to provide some insights into the effects on this population.

This study also had some limitations. This study used cross-sectional data; thus causality and directionality cannot be determined. Another limitation related to causality is that the father-child feeding relationship is bidirectional. As no child data were collected, only the father self-

reported data were used in these analyses. Also, father self-report of food-parenting practices are susceptible to social desirability bias (Khandpur et al., 2016).

Overall, this study provides valuable insights about the food-parenting styles and food-parenting practices of fathers of school-aged children. This study highlights the potential benefits of increasing the nutrition knowledge of fathers as an important strategy to promote healthy child weight outcomes. These findings emphasize the importance of integrating fathers into childhood obesity prevention research.

CHAPTER III: PHASE 2: FATHER DIET QUALITY AND ASSOCIATION WITH CHILD BMI PERCENTILE

Introduction

Childhood overweight and obesity continues to be a national health concern with an estimated 19% of U.S. children and adolescents categorized as obese (Hales et al., 2017). Poor diet quality has been associated with a higher risk of obesity and chronic diseases over the lifespan (Hiza et al., 2013). Moreover, the prevalence of obesity is higher for African American (AA) and Hispanic children at 22% and 26%, respectively, as compared to non-Hispanic white children, at 14% (CDC, 2019c). The causes of childhood obesity are multifactorial and include genetics, excess caloric intake, obesogenic environments, and the socio-ecological influences present in the child's home, school, and community (Kumar & Kelly, 2017).

Diet quality can be examined in the context of an individual's dietary pattern. A dietary pattern includes the foods and beverages which are consumed in various combinations over time (Dietary Guidelines Advisory Committee, 2020b). Dietary patterns are relevant to diet quality and when examining the factors related to energy imbalance and child weight gain (van der Horst et al., 2006). Healthier diet patterns are characterized by higher intakes of fruits, vegetables, whole grains, and lean proteins and lower intakes of sodium, saturated fat, and added-sugars (Dietary Guidelines Advisory Committee, 2020a).

The Healthy Eating Index 2015 (HEI-2015) is a measure developed by the USDA to identify how well an individual's diet pattern aligns with the *2015-2020 Dietary Guidelines for Americans* (USDA Food and Nutrition Service, 2019). The HEI-2015 includes 13 components

which sum to a possible score of 100 (USDA Food and Nutrition Service, 2019). A higher HEI-2015 score indicates a healthier diet pattern.

Children, especially prior to adolescence, are mostly dependent on parents and caregivers for access to healthier dietary options as they have less autonomy when choosing foods and beverages (van der Horst et al., 2006). Additionally, healthier parent diet patterns reported collectively as "parents" (54% mothers; 42% fathers) was found to encourage a healthier child eating pattern and be associated with healthier child weight outcomes (Variyam, 2001). More recently, Hall et al. (2011) examined whether the dietary intake of overweight fathers was associated with their primary school-aged child's dietary intake. Significant associations were found between father-child intakes: fruit ($r = 0.40$, $p < 0.01$); cookies ($r = 0.54$; $p < 0.001$); and potato chips ($r = 0.33$; $p < 0.05$) (Hall et al., 2011). However, no significant associations were found between vegetable, ice cream, chocolate, or French fry intake ($p > 0.05$) (Hall et al., 2011). Although there is some evidence of an association between parental intake of fruits and vegetables and the child's fruit and vegetable intake, the effects of maternal vs. paternal influences are not well understood as few studies differentiate between the caregivers (van der Horst et al., 2006).

A healthier diet pattern may also be influenced by an individual's knowledge of key nutrition concepts resulting in improved dietary selection. A systematic review evaluated the association between nutrition knowledge and dietary intake of adults $\geq$ 18 years old (Spronk et al., 2014). Greater nutrition knowledge was positively associated with higher intake of fruits and vegetables and lower amounts of unhealthy fats (Spronk et al., 2014). Further, higher parent nutrition knowledge has been correlated with healthier child weight outcomes (Variyam, 2001).

Although some evidence has been found regarding the potential influence of the father diet pattern on the child diet pattern, few studies have examined the association between the father diet pattern, nutrition knowledge, and child weight outcome. Thus, the primary aim of this study was to test a model in which fathers' diet pattern was a predictor of child BMI percentile and to examine father nutrition knowledge as a moderator of this association. I hypothesized that a higher father HEI-2015 score, i.e., healthier father diet pattern, would be associated with a decrease in child BMI percentile. Additionally, the association between a higher father HEI-2015 score, i.e., healthier father diet pattern, and decrease in child BMI percentile would be strengthened for those fathers with higher nutrition knowledge.

Methods

The following procedure was approved by the UNCG Institutional Review Board. Upon completion of two ASA24-2020 diet records each father received a $25 online Amazon gift card.

Participants

Participants (n = 407) who provided opt-in interest upon completion of the nutrition knowledge and food-parenting styles and food-practices (phase 1) of the study were recruited to participate (Appendix H). Eligible participants (n = 328) were contacted via the provided email address with a description of the study and a link to the informed consent in Qualtrics (Appendix D). Seventy-nine participants were not eligible as an email address was not associated with their survey response. Participants (n = 118) who recorded their consent in Qualtrics received a follow-up email with the following information: 1. participant ID and password, 2. link to the ASA24 respondent website, 3. instructions for recording their dietary intake using the ASA24-2020 website, 4. researcher contact information in the event of questions or issues with the

ASA24-2020 website, and 5. a sample Respondent Nutrition Report (National Cancer Institute, 2020b).

The Respondent Nutrition Report is an optional benefit to participants when completing their diet record using the ASA24-2020 tool (National Cancer Institute, 2020b). The report provides feedback to the ASA24-2020 participant about how their 2-days of reported food and beverage intake aligns with the *2015-2020 Dietary Guidelines for Americans* for their sex and age category. Participants used a personal computer, tablet, or mobile device to sign into the ASA24-2020 website and to record their dietary intake.

Participants (n = 51) with two completed 24-h dietary recalls were included in these results. Data collection began in June 2021 and is ongoing with the objective of collecting two diet records for 125 participants by the end of 2021.

Child BMI Percentile

Child measurements and derivation of child BMI is described in the phase 1 study. Briefly, medical provider reported, patient-portal child measurements of height and weight were used to compute BMI (kg/m2) values using the age and sex CDC growth chart guidelines to define BMI percentile (CDC, 2019a). For the purposes of interpretation, the child BMI-for-age categories are as follows: underweight (< 5^{th} percentile); healthy weight (5^{th} to < 85^{th} percentile); overweight (85^{th} to < 95^{th} percentile); obese ($\geq$ 95^{th} percentile) (CDC, 2019a). Child BMI was derived as a continuous variable according to the CDC BMI-for-age percentiles.

Father Dietary Intake

Participants were asked to complete two 24-h dietary recalls representative of their dietary intake for one workday and one non-work (weekend) day using the web-based Automated Self-Administered 24-h 2020 (ASA24-2020) Assessment Tool (National Cancer

Institute, 2020b). Per previous research, one weekday and one weekend day are needed to collect valid dietary data (Moshfegh et al., 2008).

The ASA24-2020 was developed by the National Cancer Institute to enable the collection of participant-administered 24-h dietary recalls (National Cancer Institute, 2020a). The ASA24 has been validated and evaluated with a large, heterogenous population to compare performance of the ASA24 with a standard interviewer-administered 24-h dietary recall (Thompson et al., 2015). Close agreement was found between the ASA24 and standard interviewer-administered 24-h dietary recalls (Thompson et al., 2015). Further, attrition was found to be lower and 70% of participants preferred the ASA24 over the interviewer-led diet collection (Thompson et al., 2015).

The ASA24-2020 employs the five-step automated multiple pass method (AMPM) developed by the USDA (Food Surveys Research Group, 2020). The first step of the AMPM is unstructured and allows the participant to list all food and beverages consumed during the 24-h period. The next three steps utilize various probes and a structured approach to elicit the participant's recollection of all foods and beverages consumed. The fifth step is unstructured and includes a final set of memory cues to probe for any forgotten food and beverages.

Father HEI-2015 Score

Fathers' diet quality was described by the HEI-2015 score. The HEI-2015 score was derived for each participant using the diet records collected via the ASA24-2020. The HEI-2015 score is a reliable and valid dietary quality index developed by the USDA which indicates how well an individual's diet agrees with federal dietary guidelines (Krebs-Smith et al., 2018).

The HEI-2015 score is a continuous variable based on the summed score of 13 dietary components representing the diet groups and subgroups composing a balanced, adequate diet

(USDA Food and Nutrition Service, 2019). The 13 dietary components are broken into two categories: adequacy and moderation (Reedy et al., 2018). The category of adequacy includes nine components: total fruits, whole fruits, total vegetables, greens and beans, whole grains, dairy, total protein foods, seafood and plant proteins, and fatty acids. The category of moderation includes components to consume in moderation: refined grains, sodium, added sugars, and saturated fats. The scores for the 13 components are summed for a total score (0 – 100).

Table 8 provides an overview of the 13 dietary components, the point values, and the standards of scoring for each component (Reedy et al., 2018). The 13 dietary components which compose the HEI-2015 score are equally weighted in the derivation of the score (Krebs-Smith et al., 2018). For categories of the diet represented by two components, such as fruit, the maximum score for each individual component in that category is a 5. For categories of the diet represented by one component, the maximum score is a 10 for that component (Krebs-Smith et al., 2018).

Table 8: HEI-2015 dietary components, point values, standards of scoring.

Component	Maximum Points	Standard for maximum score	Standard for minimum score
Adequacy components			
Total Fruits	5	$\geq$ 0.8 c equivalents/1,000 kcal	No fruit
Whole Fruits	5	$\geq$ 0.4 c equivalents/1,000 kcal	No whole fruit
Total Vegetables	5	$\geq$ 1.1 c equivalents/1,000 kcal	No vegetables
Greens and Beans	5	$\geq$ 0.2 c equivalents/1,000 kcal	No dark green vegetables or beans and peas
Whole Grains	10	$\geq$ 1.5 oz equivalents/1,000 kcal	No whole grains
Dairy	10	$\geq$ 1.3 c equivalents/1,000 kcal	No dairy
Total Protein	5	$\geq$ 2.5 oz equivalents/1,000 kcal	No protein foods

Component	Maximum Points	Standard for maximum score	Standard for minimum score
Foods			
Seafood and Plant Proteins	5	≥ 0.8 c equivalents/1,000 kcal	No seafood or plant proteins
Fatty Acids	10	(PUFAs[1]+MUFAs[2])/SFAs[3] ≥ 2.5	(PUFAs[1]+MUFAs[2])/SFAs[3] ≤ 1.2
Moderation components			
Refined Grains	10	≤ 1.8 oz equivalents/1,000 kcal	≥ 4.3 oz equivalents/1,000 kcal
Sodium	10	≤ 1.1 g/1,000 kcal	≥ 2.0 g/1,000 kcal
Added Sugars	10	≤ 6.5% of kcal	≥ 26% of kcal
Saturated Fats	10	≤ 8% of kcal	≥ 16% of kcal

1. PUFAs = polyunsaturated fatty acids.
2. MUFAs = monounsaturated fatty acids.
3. SFAs = saturated fatty acids.

To derive a HEI-2015 score for each participant, the ASA24-2020 SAS macro, the Simple HEI Scoring Algorithm - Per Person, was used (Division of Cancer Control & Population Sciences, 2020). The ASA24-2020 SAS macro derived the HEI-2015 score as a continuous variable using two 24-hour dietary recalls (one weekday and one weekend day) collected via a multiple pass procedure via the web-based ASA24-2020 tool. The ASA24-2020 dietary data was coded using the Food and Nutrient Database for Dietary Studies. The coded dietary data was used to derive a HEI-2015 score ranging from 0 - 100.

Father Nutrition Knowledge

Father nutrition knowledge was represented by a nutrition knowledge score derived from data collected in the first phase of this research. Briefly, fathers' nutrition knowledge was a continuous variable. A total of 18 questions assessed four areas of fathers' nutrition knowledge: 1. knowledge of dietary recommendations, 2. sources of nutrients, 3. everyday food choices, and 4. diet-disease relationships. Father responses to each question was scored as 1 point if correct

and 0 if incorrect. The summed score resulted in a possible score of 0 - 18. A higher nutrition knowledge score indicated higher nutrition knowledge.

Data Analysis

All analyses were conducted in SAS (version 9.4, SAS Institute Inc., Cary, NC, 2008). To determine significance, $p < .05$ was used for all analyses. Descriptive statistics and multiple regression modeling investigated the specific aim (specific aim 2) and the associated hypotheses. Descriptive information (race, ethnicity, age, education, income) was collected during phase 1 of the study. Mean distributions of father HEI-2015 scores were generated. To test the study hypotheses, multiple regression models were generated.

For purposes of analysis, race, income, and education categories were collapsed due to low sample size. Ethnicity was unchanged: non-Hispanic or Hispanic. Race was collapsed into three categories: 1.white, 2. black, and 3. other (Asian, Native American, Alaska Native, Native Hawaiian, Pacific Islander, multi-racial). Household income was collapsed into four categories: 1. < $35k; 2. $35 – 50k; 3. $50k – $75k; and 4. > $75k. Education categories were collapsed into four categories: 1. high school or less, 2. some college, vocational school, associate degree, 3. bachelor's degree, and 4. graduate degree.

To test the first hypothesis, a multiple regression model was utilized to investigate the association between fathers' HEI-2015 score and child BMI weight percentile. Socio-demographic categorial variables were automatically dummy-coded using the class option. The reference category for each socio-demographic category was as follows: ethnicity = non-Hispanic; race = white; household income = > $75k; education = graduate degree.

Using the class option dummy variables were created for each socio-demographic category (Pasta, 2005). Two dummy variables for race were created: 1. race = black (yes or no)

and 2. race = other (yes or no). Therefore, race = white corresponded to the reference in the instance where race black = 0 and race other = 0. In similar fashion, three dummy variables for household income were created: 1. household income < $35k (yes or no); 2. household income = $35 – 50k (yes or no); 3. household income = $50k – $75k (yes or no), with reference category = > $75k. Finally, three dummy variables for education were created: 1. Education = high school or less (yes or no); 2. Education = some college, vocational school, associate degree (yes or no); 3. Education = bachelor's degree (yes or no), with reference category = graduate degree.

To test the second hypothesis, a moderated multiple regression model examined the effect of father nutrition knowledge on the association between father HEI-2015 score and child BMI percentile. Interaction terms for the moderation analysis was computed by multiplying the mean-centered variables: father nutrition knowledge with the father HEI-2015 variable (Baron & Kenny, 1986).

Results

Of the consented participants (n = 118), 43% of fathers (n = 51) completed the requested two 24-hour dietary recalls at the time of this data analysis. Descriptive data were available for 42 fathers. Nine fathers were excluded from the descriptive and regression analyses due to missing survey (phase 1) email information which prevented the cross-reference of diet and survey the records. The father diet quality measure (HEI-2015 score) and analysis were reported for all father participants (n = 51).

Descriptive Characteristics

Descriptive statistics and associated analyses for participants (n = 42) were conducted using the survey (phase 1) records to identify demographic characteristics and child weight status (Table 9). Of the 42 father participants, 93% were non-Hispanic white, 40% reported a

bachelor's degree or higher, > 60% reported earnings of at least $50k, 33% participated in WIC, and 26% in SNAP. Of those participants who reported food security (*n* = 38), 68% of fathers reported high or marginal household food security, 29% reported low household food security, and 3% reported very low household food security (3%).

Table 9: Descriptive characteristics of father diet study participants (*n* = 42).

Characteristic	Number of participants	% of participants
Race		
White	39	93%
Black Americans	0	
Native American or Alaskan native	1	2%
Asian	0	
Hawaiian or Pacific Islander	0	
Other/multiracial	2	5%
Ethnicity		
Not Hispanic or Latino	41	98%
Hispanic or Latino	1	2%
Education		
High school or less	5	12%
Vocational school	1	2%
Some college	15	36%
Associate Degree	4	10%
Bachelor's Degree	3	7%
Graduate Degree	14	33%
Income		
Less than $15,000	0	
$15,000 to $24,999	1	2%
$25,000 to $34,999	4	10%
$35,000 to $49,999	9	21%
$50,000 - $74,999	16	38%
more than $75,000	12	29%
Household characteristics		
WIC	14	33%
SNAP	11	26%
Household food security[1]		
High or marginal food security	26	68%

Characteristic	Number of participants	% of participants
Low food security	11	29%
Very low food security	1	3%

1. n = 38; data missing for 4 participants.

Father Diet Quality

The HEI-2015 score was a proxy for father diet quality with a higher score (0-100) indicating greater agreement with the recommendations of a healthy dietary pattern as described in the *2015-2020 Dietary Guidelines for Americans.* The mean participant HEI-2015 score (n = 51) was 58.62 (SD ±11.54).

The distribution of mean father HEI-2015 scores according to child weight status is shown in Table 10. The mean father HEI-2015 scores were lower for the child BMI-for age categories of overweight and obese. The mean father HEI-2015 scores were higher for the child BMI-for-age categories of underweight and healthy weight.

Table 10: Mean Father HEI-2015 score by child weight status (n = 42).

Child weight status	N	Mean HEI score	SD	Minimum	Maximum
Underweight	5	65.80	12.28	53.00	84.00
Healthy weight	24	60.29	9.71	42.00	81.00
Overweight	11	54.00	12.97	34.00	77.00
Obese	2	46.00	11.31	38.00	54.00

Multiple Regression Model - Specific Aims and Hypotheses

This phase of the study investigated specific aim two which evaluated whether a healthier father diet pattern was a predictor of child BMI percentile and if father nutrition knowledge moderated this association. There were two associated hypotheses: 1. a higher father HEI-2015 score, i.e., healthier father diet pattern, would be associated with a decrease in child BMI percentile, and 2. the association between a higher father HEI-2015 score, i.e., healthier father

diet pattern, and decrease in child BMI percentile would be strengthened for those fathers with higher nutrition knowledge.

Specific Aim 2

A multiple regression model was used to predict child BMI percentile from father HEI-2015 score. The overall model was significant and explained 45% of the variance in child BMI percentile (r^2 = 0.4525; F = 2.94; p = 0.0117). Table 11 displays the results of the model.

Table 11: Multiple regression predicting child BMI percentile from father HEI-2015 score.

Predictor	β*	B*	±SE	*p*-value
HEI-2015 score	-0.3704	- 1.1078	0.1460	**0.0162**
Covariates±				
Race				0.2803
Other	-0.6202	-21.4065	0.5649	0.2803
Ethnicity				0.4931
Hispanic	0.6817	23.5228	0.9832	0.4931
Education				0.0514
High school or less	-0.3167	-10.9276	0.5735	0.5846
Some college, vocational school, associate degree	-0.4063	-14.0184	0.4700	0.3938
Bachelor's degree	-1.2271	-42.3402	0.4639	**0.0126**
Income				0.0729
< $35k	0.2384	8.2271	0.5789	0.6832
$35k - $50k	-0.6590	-22.738	0.5673	0.2540
$50k - $75k	0.3334	11.5030	0.5027	0.5120

*β is the standardized and B is the unstandardized regression coefficient.
±Covariates: race: white (ref), other; ethnicity: Hispanic, non-Hispanic(ref); father education: high school, vocational school, some college, associate degree, bachelor's degree, graduate degree or higher (ref); household income: < $35k, $35-$50k, $50k-$75k, > $75k (ref).

Hypothesis 1

When controlling for all other variables, the fathers' HEI-2015 score was significantly related to child BMI percentile (β = - 0.3704; SE = 0.1460; p = 0.0162). In this study population, a 1-point increase in father HEI-2015 score predicted a modest decrease in child BMI percentile of 0.3704, thus supporting this hypothesis.

Hypothesis 2

A multiple regression model assessed whether father nutrition knowledge moderated the association between a healthier father diet pattern and child BMI percentile. The overall model was not significant (r^2 = 0.0993; F = 1.40; p = 0.2588). Thus, the results of the moderation analysis did not support the second hypothesis. Table 12 displays the results of the model.

Table 12: Multiple regression predicting child BMI percentile from the interactive effect between father HEI-2015 score and father nutrition knowledge.

Predictor	β*	B*	±SE	*p*-value
Father nutrition knowledge score	- 0.0016	- 0.0844	2.2028	0.9697
HEI-2015 score	- 2.3719	- 12.4084	1.8203	0.7074
Moderator – Father nutrition knowledge	- 1.0165	- 0.6857	0.1412	0.8064

*β is the standardized and B is the unstandardized regression coefficient.

Discussion

This study provides insight into the association between the father's dietary pattern and the referent child's BMI percentile by testing two hypotheses: 1. a higher father HEI-2015 score, i.e., healthier father diet pattern, would be associated with a decrease in child BMI percentile and 2. the association between a higher father HEI-2015 score, i.e., healthier father diet pattern, and decrease in child BMI percentile would be strengthened for those fathers with higher nutrition knowledge. The results of this study supported the first hypothesis. In this study population, a 1-point increase in father HEI-2015 score predicted a modest decrease in child BMI percentile of 0.3704. However, the results did not support the second hypothesis. In this study population, higher father nutrition knowledge did not significantly strengthen the association between a healthier father dietary pattern and child BMI percentile.

The statistically significant association between an increase in father HEI-2015 score and a modest decrease in child BMI percentile suggests that a healthier father diet pattern may influence a healthier child weight trajectory. A number of factors, informed by Bronfenbrenner's Ecological Systems Theory (EST), may influence children's biology, behaviors, and weight outcomes (Bronfenbrenner & Evans, 2000). Family factors, such as number of children in the household, parent's BMI, and parents' diet behaviors are hypothesized to influence child weight outcomes (Davison & Birch, 2001). Societal, demographic, and community characteristics, which include socioeconomic status factors, such as education attainment and household income, may influence weight outcomes in children (Davison & Birch, 2001).

In this study population, a 1-point increase in the HEI-2015 diet score and a bachelor's degree were significantly related to decreases in child BMI percentile. Although fathers with a bachelor's degree only accounted for 7% of fathers (n = 3), one of the fathers reported the highest HEI-2015 score (85) of all participants. This is consistent with previous research which also found that better diet quality was associated with higher levels of education (Hiza et al., 2013).

The average HEI-2015 participant score was 58.62 (SD ±11.54). This is consistent with the average HEI-2015 score of 58 for American adults aged 18-64 years (USDA Food and Nutrition Service, 2019). However, a HEI-2015 score of 58 falls short of aligning with the *2015-2020 Dietary Guidelines for Americans*. The mean father HEI-2015 scores and the distribution of father HEI-2015 scores by household income and level of father education data are also provided in table and figure format in Appendices M and N, respectively. Otherwise, the participant HEI-2015 scores ranged from a low score of 32 and a high score of 85. About half of the participants had a HEI-2015 score of 60 or higher.

The mean HEI-2015 score of the study participants (58.62) was equivalent to that of U.S. adults (58.3) according to 2015-2016 NHANES data (USDA Food and Nutrition Service, 2019). A recent study which evaluated the construct validity and reliability of the HEI-2015 measures also examined the known differences between groups, such as differences by sex (Reedy et al., 2018). The mean HEI-2015 score for adult women (mean = 59.7) was higher than the mean for adult men (mean = 57.2) (Reedy et al., 2018). The mean HEI-2015 score for the men in this study was slightly higher than the average score for a nationally representative sample of adult men.

A closer look at the 13 dietary components of the HEI-2015 score may also provide insight into the similarities and differences between the study participant and US adult population scores. Table 13 provides a comparison of the mean U.S. adult (18-64 years) score by dietary component compared to the study participant scores (USDA Food and Nutrition Service, 2019).

Table 13: Comparison of mean HEI-2015 score components: US adults and study participants.

Component	Maximum Points	Mean U.S. adult[1] score (18-64 y)	Mean participant score
Total Mean HEI Score		58.3	58.4
Adequacy			
Total Fruits	5	2.6	2.3
Whole Fruits	5	3.8	2.7
Total Vegetables	5	3.5	4.4
Greens and Beans	5	3.4	3.1
Whole Grains	10	2.7	3.3
Dairy	10	5.4	5.4
Total Protein Foods	5	5.0	4.5
Seafood and Plant Proteins	5	5.0	3.4
Fatty Acids	10	4.5	5.6
Moderation			
Refined Grains	10	6.7	7.9
Sodium	10	3.4	2.4

Component	Maximum Points	Mean U.S. adult[1] score (18-64 y)	Mean participant score
Added Sugars	10	6.8	9.0
Saturated Fats	10	5.4	4.9

1. Based on nationally representative sample of U.S. male and female adults

As noted previously, the adequacy category includes dietary components which are encouraged as part of a healthy diet. For example, a higher score in the adequacy category of total vegetables indicates a higher intake of vegetables. The maximum score of 10 for vegetables translates to vegetable intake $\geq$ 1.1 cup equivalents/1,000 kcal of dietary intake (Reedy et al., 2018). Alternatively, the moderation category includes dietary components to limit as part of a healthy diet. For example, a higher score in the moderation category of added sugars represents a diet with a lower intake of added sugars as a percent of total dietary intake. The maximum score of 10 for added sugars translates to added sugar intake $\leq$ 6.5% of total caloric intake (Reedy et al., 2018).

In this study population, the participants scored higher in total vegetable, whole grain, and fatty acids intake as compared to U.S. adults. Additionally, the average study participant diet contained less refined grains and added sugars as compared to U.S. adults. However, average sodium intake tracked higher than the national average for adults.

There were important differences between the adequacy and moderation component scores of study sample and the U.S. adult population. Regarding adequacy, the fathers in this study population scored the same for dairy and higher in the total vegetable, whole grain, and fatty acids categories than the national population of adults. Compared to US adults, the fathers in this study reported consuming fewer refined grains and added sugars. However, the average sodium and saturated fat components were higher than the national average for adults.

A possible explanation for the differences in the adequacy and moderation components may be attributed to the father's role in parenting his school-aged child. With the passage of the Healthy, Hunger-Free Kids Act in 2010, there has been increased emphasis on increasing the intakes of whole grains, vegetables, and fruit and reducing the intake of refined grains, added sugars, and sodium (USDA Food and Nutrition Service, 2013). Additionally, as noted previously, this study population reported higher levels of education which is associated with increased diet quality in previous research (Hiza et al., 2013). Interestingly, Hiza et al. (2013) also concluded that although diet quality increased with higher education and income, sodium levels did not change or improve which was consistent with this study population. The higher intake of saturated fat may be attributed to more convenience foods which would also influence the higher sodium value.

Although the HEI-2015 score provides some insight into dietary patterns, it is important to remember the HEI-2015 score represents only a single dimension of the individual's overall dietary pattern quality (Krebs-Smith et al., 2018). The score is meant to represent the quality of the individual's food and beverage intake, not the degree of nutrient adequacy (Kirkpatrick et al., 2018). To date, a recommended approach to interpret the HEI-2015 score has not yet been defined, one way to interpret the HEI-2015 score is according to the standard grading scales: A (90-100), B (80-89), C (70-79), D (60-69), and F (< 59) (Krebs-Smith et al., 2018). However, researchers and practitioners are encouraged to use the numeric score in combination with the grade, to interpret the score (Kirkpatrick et al., 2018).

As noted, the second hypothesis was not significant. In this study population, higher father nutrition knowledge did not significantly strengthen the association between a healthier father dietary pattern and child BMI percentile. Although the results of this study did not

support this hypothesis, higher father nutrition knowledge and a healthier father dietary pattern may result in a reduction in child BMI percentile, i.e., a healthier child weight outcome. The relationship between parent nutrition knowledge and reduced risk of child overweight outcomes has been supported in previous literature, though there is scant literature which report findings for fathers. For example, a previous study with parent-child dyads (n = 1,825) aged 6-17 years, found that as parent nutrition knowledge increased the risk of child overweight decreased (Variyam, 2001). Although 42% of the included parents were fathers, mother and father nutrition knowledge were reported collectively as parent. Though there have been more studies which have examined the relationship between fathers diet quality and child weight status, most have focused on preschool-aged children (Vollmer et al., 2015). Other studies have investigated the role of the collective caregivers or the maternal diet as a predictor, but few have investigated father diet as a predictor of child weight outcomes (Davison et al., 2016). To better understand whether these father attributes might influence child weight outcomes independently or synergistically, studies with a larger, more heterogenous population are needed.

This study included several strengths and limitations. The assessment of father diet quality was based on two 24-hour dietary recalls administered via the validated ASA24-2020 software. The derivation of the HEI-2015 score was based upon this validated measure. The investigation into the association of father diet quality with changes in child BMI percentile was also a strength and adds to the literature.

Limitations included the small sample size and homogeneity of the participants, which limits the generalizability of the study findings. Additionally, the data were self-reported which may contribute to reporting error. It is also important to consider the other factors involved in establishing a healthy dietary pattern, such as the overall energy balance and adequate nutrient

intake which is not considered in the calculation of the HEI-2015 score (Krebs-Smith et al., 2018). Last, there are limitations to the collection of dietary data collected via 24-hour recalls. Although the validity of the Automated Multiple-Pass Method has been established, the differences in under-reporting by weight status remain a limitation (Moshfegh et al., 2008). It is also not known how under- or over-reporting can influence differences in diet quality measures.

Despite these limitations, the study findings contribute insights to research investigating the potential role of fathers' diet patterns and childhood weight outcomes. An understanding of fathers' diet quality, and the potential role in healthier child outcomes, may have important implications for family-based childhood obesity prevention programming.

CHAPTER IV: EPILOGUE

The two phases of this study contribute to the literature examining father food-parenting practices, nutrition knowledge, and diet quality and how these may influence changes in their school-aged child's weight status. Fathers help shape what families eat and thus their personal diet preferences, nutrition knowledge, and food preparation skills influence the food in the home that is purchased, prepared, and consumed by school-aged children. Forty years ago, fathers spent 30% the equivalent time on child care responsibilities as their spouse; recently, it is estimated this has now increased to 67% on weekdays and 87% on weekend days (Khandpur et al., 2014). Of 436 fathers who participated in a recent Father Feeding Study, 71% responded they should share equal responsibility with the mother when feeding their child, and 26% were interested in increasing their participation in feeding their child (Peeters et al., 2019).

Of the 407 fathers in this study, 53% of fathers reported they participate in food shopping, meal preparation, and portioning meals and snacks for their school aged child at least half the time. The fathers in this study were impacted by the COVID-19 pandemic with 63% indicating they began working from home due to pandemic restrictions. This increased the frequency of meals shared with their child for 40+% of fathers and 18% indicated a significant change in food shopping. Although about 50% of fathers who participated in the survey indicated a high degree of self-efficacy preparing fruit for child meals, only about a third reported a high degree of efficacy preparing vegetables.

The findings from this research support the growing evidence that many fathers participate in child-feeding activities. Thus, father child-feeding behaviors, nutrition knowledge, and diet quality may positively and negatively influence child weight outcomes. Additionally,

fathers' contributions may be unique depending on sociodemographic factors. While the first phase of the study included a heterogenous population, the second phase was composed of non-Hispanic white fathers with higher education and income. Further research with sociodemographic diverse fathers would be beneficial for the development of targeted father and family-based childhood obesity prevention programming. As shown in this study, programs which foster improvement in father nutrition knowledge may be a beneficial strategy to promote healthy child weight outcomes.

The administration of this study was not without challenges. Conducting human research during the COVID-19 pandemic required adjustments to comply with social distancing guidelines. Thus, all interactions with the participants were conducted online for both phases of the study. The survey (phase 1) utilized the Qualtrics XM™ survey software supported by the University. Qualtrics XM™ is a flexible platform for survey data collection. However, there were some key learnings related to the security of the survey.

The survey security parameters were set to prevent users from taking the survey multiple times (ballot box stuffing) and to prevent search engines from identifying the survey link via a web search (indexing). However, adding captcha to add an extra layer of protection against viral and bot activity is recommended. Unexpectedly, this survey went "viral" and required a close examination of all collected records with the help of the UNCG 6-Tech team. Although captcha adds an extra layer of security, it also adds some additional participant burden. However, the extra burden is minimal and many individuals who participate in online activities are likely familiar with this added layer of security.

Participant recruitment and reminder follow-up was conducted via email. The Cone Health participant recruitment email was sent from an internal executive's office to ensure the

emails were not flagged as spam. However, the UNCG recruitment emails were sent via the PI's UNCG email address. An email was sent to the provided UNCG email addresses with the email addresses listed in the BCC address area to protect the privacy of the potential participants. However, it was learned that sending emails this way, especially with many email addresses, would potentially lead to the email being delivered to recipient spam or junk folders instead of their inbox.

Consultation with the UNCG 6-TECH team led to the awareness of a recommended add-on service offered by Google mail (Gmail) to prevent this issue: Yet Another Mail Merge (YAMM). According to the UNCG 6-TECH team, Gmail uses proprietary algorithms to identify suspected spam activity. Emails sent consecutive times, such as follow-up recruitment emails, will eventually be identified as spam per the Gmail spam algorithms. The YAMM add-on was adopted for use with the diet and focus group recruitment emails.

Briefly, YAMM enables mass emails to be sent using Google sheets and Gmail. A draft email is prepared and saved in the Gmail draft folder. A Google sheet is created with the email addresses of the recipients. When the YAMM add-on is enabled, an email is sent to each recipient individually using an algorithm that delivers the email to the recipient's inbox.

YAMM includes several features which support efficient recruitment and follow up with participants. YAMM automatically generates a tracking report which tracks opened emails, clicks on hyperlinks, responses, bounced emails, and any unsubscribes in real time from the Google sheet. The use of YAMM created the opportunity for more targeted email campaigns and provided great tools for tracking participant interest and participation.

The use of the ASA24-2020 tool for father diet data collection (phase 2) was mostly seamless. The user interface is well-designed and only a couple of participants experienced

problems. The support from the ASA24-2020 team was also very helpful. Only one issue had to be elevated to the support team and it was resolved within two hours. Though participation was below the target of 125 participants, the recruitment and completion rate were consistent.

Regular follow-up and monitoring of completion were needed to remind participants to complete the 2nd day. Most respondents completed a weekday first, thus the weekend day required the participant to remember to log back into the system 2-5 days later. Thus, the timing of the reminder emails worked best on Fridays and Mondays. This way the participant was reminded to complete the 2nd day of intake before and after the weekend. This presumes the workweek for the participant is Monday – Friday. A more diverse population may have a weekday "weekend." Thus, reminders during the week were also trialed, but did not significantly impact participation.

Conclusions

Overall, this study generated useful insights about fathers' contributions to child feeding and associations with child weight outcomes. This exploratory research provides a foundation for future researchers to expand upon. Future researchers should continue to explore the observations identified in these collective studies in the interest of informing family-based childhood obesity prevention programming that is relevant for both parents.

REFERENCES

Adams, E. L., Caccavale, L. J., Smith, D., & Bean, M. K. (2020). Food insecurity, the home food environment, and parent feeding practices in the era of COVID-19. *Obesity (Silver Spring)*, *28*(11), 2056-2063. https://doi.org/10.1002/oby.22996

Ambikapathi, R., Passarelli, S., Madzorera, I., Canavan, C. R., Noor, R. A., Abdelmenan, S., Tewahido, D., Tadesse, A. W., Sibanda, L., Sibanda, S., Munthali, B., Madzivhandila, T., Berhane, Y., Fawzi, W., & Gunaratna, N. S. (2021). Men's nutrition knowledge is important for women's and children's nutrition in Ethiopia. *Matern Child Nutr*, *17*(1), e13062. https://doi.org/10.1111/mcn.13062

American Community Survey. (2020). *Poverty status in the past 12 months of families*. U.S. Census Bureau,. Retrieved January 13, 2020 from https://data.census.gov/cedsci/table?q=S1702&g=0100000US_0400000US37_0500000US37081&tid=ACSST1Y2019.S1702&hidePreview=true

Baron, R. M., & Kenny, D. A. (1986). The moderator-mediator variable distinction in social psychological research. conceptual, strategic, and statistical considerations. *Journal of Personality and Social Psychology*, *51*(6), 1173-1182. https://doi.org/10.1037/0022-3514.51.6.1173

Barrera, M., & Caples, H. (2001). The psychological sense of economic hardship: measurement models, validity, and cross-ethnic equivalence for urban families. *American Journal of Community Psychology*, *29*(3), 493-517. https://doi.org/10.1023/A:1010328115110

Birch, L. L., Fisher, J. O., Grimm-Thomas, K., Markey, C. N., Sawyer, R., & Johnson, S. L. (2001). Confirmatory factor analysis of the Child Feeding Questionnaire: a measure of parental attitudes, beliefs and practices about child feeding and obesity proneness. *Appetite*, *36*(3), 201-210. https://doi.org/10.1006/appe.2001.0398

Bronfenbrenner, U., & Evans, G. W. (2000). Developmental Science in the 21st Century: Emerging Questions, Theoretical Models, Research Designs and Empirical Findings. *SOCIAL DEVELOPMENT*, *9*(Part 1), 115-125.

CDC-DNPAO, D. o. N., Physical Activity, and Obesity) (2019). *A SAS program for the 2000 CDC Growth Charts (ages 0 to < 20 years)*. CDC. Retrieved August 14, 2020 from https://www.cdc.gov/nccdphp/dnpao/growthcharts/resources/sas.htm

CDC. (2019a). *About Child and Teen BMI*. Retrieved October 14, 2019. from https://www.cdc.gov/healthyweight/assessing/bmi/childrens_bmi/about_childrens_bmi.html

CDC. (2019b). *Health and economic costs of chronic diseases*. Retrieved December 28, 2019 from https://www.cdc.gov/chronicdisease/about/costs/index.htm

CDC. (2019c, June 24, 2019). *Prevalence of Childhood Obesity in the United States*. Retrieved September 13, 2019 from https://www.cdc.gov/obesity/data/childhood.html

CDC. (2021). *Overweight and Obesity*. Retrieved August 8, 2021 from https://www.cdc.gov/obesity/index.html

Chen, Y. C., Fan, H. Y., Yang, C., Hsieh, R. H., Pan, W. H., & Lee, Y. L. (2019). Assessing causality between childhood adiposity and early puberty: A bidirectional Mendelian randomization and longitudinal study. *Metabolism*, *100*, 153961. https://doi.org/10.1016/j.metabol.2019.153961

Cluss, P. A., Ewing, L., King, W. C., Reis, E. C., Dodd, J. L., & Penner, B. (2013). Nutrition knowledge of low-income parents of obese children. *Transl Behav Med*, *3*(2), 218-225. https://doi.org/10.1007/s13142-013-0203-6

Conger, R., Elder, G. H., Jr., & Elder, G. H. (1994). *Families in troubled times : adapting to change in rural America*. A. de Gruyter.

Cook, W. L., & Douglas, E. M. (1998). The looking-glass self in family context: A social relations analysis. *Journal of Family Psychology*, *12*(3), 299(291).

Cullen, K. W., Baranowski, T., Rittenberry, L., Cosart, C., Hebert, D., & de Moor, C. (2001). Child-reported family and peer influences on fruit, juice and vegetable consumption: reliability and validity of measures. *Health Educ Res*, *16*(2), 187-200. https://doi.org/10.1093/her/16.2.187

Cutrona, C. E., & Russell, D. W. (1987). The provisions of social relationships and adaptation to stress. In W. H. Jones & D. Perlman (Eds.), *Advances in Personal Relationships* (Vol. 1, pp. 37-67). JAI Press.

Davison, K. K., & Birch, L. L. (2001). Childhood overweight: a contextual model and recommendations for future research. *Obes Rev*, *2*(3), 159-171. https://doi.org/10.1046/j.1467-789x.2001.00036.x

Davison, K. K., Charles, J. N., Khandpur, N., & Nelson, T. J. (2017). Fathers' Perceived Reasons for Their Underrepresentation in Child Health Research and Strategies to Increase Their Involvement. *Matern Child Health J*, *21*(2), 267-274. https://doi.org/10.1007/s10995-016-2157-z

Davison, K. K., Gicevic, S., Aftosmes-Tobio, A., Ganter, C., Simon, C. L., Newlan, S., & Manganello, J. A. (2016). Fathers' Representation in Observational Studies on Parenting and Childhood Obesity: A Systematic Review and Content Analysis. *American journal of public health*, *106*(11), e14-e21. https://doi.org/10.2105/AJPH.2016.303391

Davison, K. K., Kitos, N., Aftosmes-Tobio, A., Ash, T., Agaronov, A., Sepulveda, M., & Haines, J. (2018). The forgotten parent: Fathers' representation in family interventions to prevent childhood obesity. *Prev Med*, *111*, 170-176. https://doi.org/10.1016/j.ypmed.2018.02.029

Day, R. D., Lewis, C., O'Brien, M., & Lamb, M. E. (2005). Fatherhood and Father Involvement: Emerging Constructs and Theoretical Orientations. In *Sourcebook of Family Theory and Research* (pp. 341-366). SAGE Publications, Inc. : 2455 Teller Road, Thousand Oaks California 91320 United States of America https://doi.org/10.4135/9781412990172.n14

Dietary Guidelines Advisory Committee. (2020a). Part D. Chapter 1: Current Intakes of Foods, Beverages, and Nutrients. In *Scientific Report of the 2020 Dietary Guidelines Advisory Committee: Advisory Report to the Secretary of Agriculture and the Secretary of Health and Human Services.* U.S. Department of Agriculture, Agricultural Research Service, Washington, DC. https://www.dietaryguidelines.gov/sites/default/files/2020-07/PartD_Ch1_CurrIntakes_first-print.pdf

Dietary Guidelines Advisory Committee. (2020b). *Scientific Report of the 2020 Dietary Guidelines Advisory Committee: Advisory Report to the Secretary of Agriculture and the Secretary of Health and Human Services.* Washington, DC: US Department of Agriculture, Agricultural Research Service. https://www.dietaryguidelines.gov/sites/default/files/2020-07/ScientificReport_of_the_2020DietaryGuidelinesAdvisoryCommittee_first-print.pdf or https://www.dietaryguidelines.gov/

Dilworth-Anderson, P., Burton, L. M., & Johnson, L. B. (1993). Reframing theories for understanding race, ethnicities, and families. In P. Boss (Ed.), *Sourcebook of Family Theories and Methods: A Contextual Approach* (pp. 627-646). Plenum Press.

Division of Cancer Control & Population Sciences. (2020). *SAS Code*. NIH. Retrieved September 8, 2021 from https://epi.grants.cancer.gov/hei/sas-code.html#f1

Draxten, M., Fulkerson, J. A., Friend, S., Flattum, C. F., & Schow, R. (2014). Parental role modeling of fruits and vegetables at meals and snacks is associated with children's adequate consumption. *Appetite*, *78*, 1-7. https://doi.org/10.1016/j.appet.2014.02.017

Economic Research Service. (2019a). *Food Security in the U.S.* U.S.D.A. Retrieved September 16, 2019. from https://www.ers.usda.gov/topics/food-nutrition-assistance/food-security-in-the-us/.

Economic Research Service. (2019b). *U.S. Adult Food Security Survey Module*. U.S.D.A. Retrieved September 13, 2019. from https://www.ers.usda.gov/media/8279/ad2012.pdf

Ek, A., Sorjonen, K., Eli, K., Lindberg, L., Nyman, J., Marcus, C., & Nowicka, P. (2016). Associations between Parental Concerns about Preschoolers' Weight and Eating and Parental Feeding Practices: Results from Analyses of the Child Eating Behavior Questionnaire, the Child Feeding Questionnaire, and the Lifestyle Behavior Checklist. *PloS one*, *11*(1), e0147257-e0147257. https://doi.org/10.1371/journal.pone.0147257

Elder, J. P., Arredondo, E. M., Campbell, N., Baquero, B., Duerksen, S., Ayala, G., Crespo, N. C., Slymen, D., & McKenzie, T. (2010). Individual, family, and community environmental correlates of obesity in Latino elementary school children. *J Sch Health*, *80*(1), 20-30; quiz 53-25. https://doi.org/10.1111/j.1746-1561.2009.00462.x

Elgar, F. J., Waschbusch, D. A., Dadds, M. R., & Sigvaldason, N. (2007). Development and Validation of a Short Form of the Alabama Parenting Questionnaire. *Journal of Child and Family Studies*, *16*(2), 243. https://doi.org/10.1007/s10826-006-9082-5

Food Surveys Research Group. (2020). *AMPM - USDA Automated Multiple-Pass Method*. USDA. Retrieved July 27, 2020 from https://www.ars.usda.gov/northeast-area/beltsville-md-bhnrc/beltsville-human-nutrition-research-center/food-surveys-research-group/docs/ampm-usda-automated-multiple-pass-method/

Fraser, J., Skouteris, H., McCabe, M., Ricciardelli, L. A., Milgrom, J., & Baur, L. A. (2011). Paternal Influences on Children's Weight Gain: A Systematic Review. *FATHERING - HARRIMAN-*, *9*(3), 252-267.

Freeman, E., Fletcher, R., Collins, C. E., Morgan, P. J., Burrows, T., & Callister, R. (2012). Preventing and treating childhood obesity: time to target fathers. *Int J Obes (Lond)*, *36*(1), 12-15. https://doi.org/10.1038/ijo.2011.198

Hales, C. M., Carroll, M. D., Fryar, C. D., & Ogden, C. L. (2017). Prevalence of Obesity Among Adults and Youth: United States, 2015-2016. *NCHS Data Brief*(288), 1-8.

Hall, L., Collins, C. E., Morgan, P. J., Burrows, T. L., Lubans, D. R., & Callister, R. (2011). Children's intake of fruit and selected energy-dense nutrient-poor foods is associated with fathers' intake. *J Am Diet Assoc*, *111*(7), 1039-1044. https://doi.org/10.1016/j.jada.2011.04.008

Hanson, K. L., & Connor, L. M. (2014). Food insecurity and dietary quality in US adults and children: a systematic review. *Am J Clin Nutr*, *100*(2), 684-692. https://doi.org/10.3945/ajcn.114.084525

Hiza, H. A. B., Casavale, K. O., Guenther, P. M., & Davis, C. A. (2013). Diet Quality of Americans Differs by Age, Sex, Race/Ethnicity, Income, and Education Level. *Journal of*

the Academy of Nutrition and Dietetics, *113*(2), 297-306. https://doi.org/https://doi.org/10.1016/j.jand.2012.08.011

Hubbs-Tait, L., Kennedy, T. S., Page, M. C., Topham, G. L., & Harrist, A. W. (2008). Parental feeding practices predict authoritative, authoritarian, and permissive parenting styles. *J Am Diet Assoc*, *108*(7), 1154-1161; discussion 1161-1152. https://doi.org/10.1016/j.jada.2008.04.008

Jones, J., & Mosher, W. D. (2013). Fathers' involvement with their children: United States, 2006-2010. *Natl Health Stat Report*(71), 1-21.

Kaur, J., Lamb, M. M., & Ogden, C. L. (2015). The Association between Food Insecurity and Obesity in Children-The National Health and Nutrition Examination Survey. *J Acad Nutr Diet*, *115*(5), 751-758. https://doi.org/10.1016/j.jand.2015.01.003

Khandpur, N., Blaine, R. E., Fisher, J. O., & Davison, K. K. (2014). Fathers' child feeding practices: a review of the evidence. *Appetite*, *78*, 110-121. https://doi.org/10.1016/j.appet.2014.03.015

Khandpur, N., Charles, J., Blaine, R. E., Blake, C., & Davison, K. (2016). Diversity in fathers' food parenting practices: A qualitative exploration within a heterogeneous sample. *Appetite*, *101*, 134-145. https://doi.org/10.1016/j.appet.2016.02.161

Kim, D. D., & Basu, A. (2016). Estimating the Medical Care Costs of Obesity in the United States: Systematic Review, Meta-Analysis, and Empirical Analysis. *Value Health*, *19*(5), 602-613. https://doi.org/10.1016/j.jval.2016.02.008

Kirkpatrick, S. I., Reedy, J., Krebs-Smith, S. M., Pannucci, T. E., Subar, A. F., Wilson, M. M., Lerman, J. L., & Tooze, J. A. (2018). Applications of the Healthy Eating Index for Surveillance, Epidemiology, and Intervention Research: Considerations and Caveats. *J Acad Nutr Diet*, *118*(9), 1603-1621. https://doi.org/10.1016/j.jand.2018.05.020

Kliemann, N., Wardle, J., Johnson, F., & Croker, H. (2016). Reliability and validity of a revised version of the General Nutrition Knowledge Questionnaire. *Eur J Clin Nutr*, *70*(10), 1174-1180. https://doi.org/10.1038/ejcn.2016.87

Krall, J. S., Wamboldt, P., & Lohse, B. (2015). Telephone and Face-to-Face Interviews with Low-Income Males with Child Care Responsibilities Support Inclusion as a Target Audience in SNAP-Ed. *J Community Health*, *40*(3), 448-456. https://doi.org/10.1007/s10900-014-9955-2

Krebs-Smith, S. M., Pannucci, T. E., Subar, A. F., Kirkpatrick, S. I., Lerman, J. L., Tooze, J. A., Wilson, M. M., & Reedy, J. (2018). Update of the Healthy Eating Index: HEI-2015. *J Acad Nutr Diet*, *118*(9), 1591-1602. https://doi.org/10.1016/j.jand.2018.05.021

Kumar, S., & Kelly, A. S. (2017). Review of Childhood Obesity: From Epidemiology, Etiology, and Comorbidities to Clinical Assessment and Treatment. *Mayo Clin Proc*, *92*(2), 251-265. https://doi.org/10.1016/j.mayocp.2016.09.017

Leung, C. W., & Tester, J. M. (2019). The Association between Food Insecurity and Diet Quality Varies by Race/Ethnicity: An Analysis of National Health and Nutrition Examination Survey 2011-2014 Results. *Journal of the Academy of Nutrition and Dietetics*, *119*(10), 1676-1686. https://doi.org/10.1016/j.jand.2018.10.011

Livingston, G. (2018). *Stay-at-home moms and dads account for about one-in-five U.S. parents*. Retrieved January 3, 2019 from https://www.pewresearch.org/fact-tank/2018/09/24/stay-at-home-moms-and-dads-account-for-about-one-in-five-u-s-parents/

Livingston, G., & Parker, K. (2019, June 12, 2019). *8 facts about American dads.* . Retrieved September 5, 2020 from https://www.pewresearch.org/fact-tank/2019/06/12/fathers-day-

facts/#:~:text=1%20More%20dads%20are%20staying%20home%20to%20care,many%20dads%20feel%20they%E2%80%99re%20not%20doing%20enough.%20
Mallan, K. M., Daniels, L. A., Nothard, M., Nicholson, J. M., Wilson, A., Cameron, C. M., Scuffham, P. A., & Thorpe, K. (2014). Dads at the dinner table. A cross-sectional study of Australian fathers' child feeding perceptions and practices. *Appetite, 73*, 40-44. https://doi.org/10.1016/j.appet.2013.10.006
Moore, T. J., Asay, S. M., & Asay, S. M. (2008). Understanding Families. In *Family resource management* (pp. 26-54). Sage Publications.
Moshfegh, A. J., Rhodes, D. G., Baer, D. J., Murayi, T., Clemens, J. C., Rumpler, W. V., Paul, D. R., Sebastian, R. S., Kuczynski, K. J., Ingwersen, L. A., Staples, R. C., & Cleveland, L. E. (2008). The US Department of Agriculture Automated Multiple-Pass Method reduces bias in the collection of energy intakes. *Am J Clin Nutr, 88*(2), 324-332. https://doi.org/10.1093/ajcn/88.2.324
National Cancer Institute. (2020a). *ASA24-2020*. National Institutes of Health. Retrieved July 24 from https://epi.grants.cancer.gov/asa24/respondent/2020.html
National Cancer Institute. (2020b). *Automated Self-Administered 24-Hour (ASA24®) Dietary Assessment Tool*. Retrieved June 12, 2020 from https://epi.grants.cancer.gov/asa24/
Park, S. H., Park, C. G., Bahorski, J. S., & Cormier, E. (2019). Factors influencing obesity among preschoolers: multilevel approach. *Int Nurs Rev, 66*(3), 346-355. https://doi.org/10.1111/inr.12513
Pasta, D. (2005). Parameterizing models to test the hypotheses you want: Coding indicator variables and modified continuous variables. Proceedings of the Thirtieth Annual SAS Users Group International Conference,
Peeters, M., Davison, K., Ma, D., & Haines, J. (2019). Meeting Report on the Conference on Fathers' Role in Children's Weight-Related Behaviors and Outcomes. *Obesity (Silver Spring), 27*(4), 523-524. https://doi.org/10.1002/oby.22396
Penilla, C., Tschann, J. M., Deardorff, J., Flores, E., Pasch, L. A., Butte, N. F., Gregorich, S. E., Greenspan, L. C., Martinez, S. M., & Ozer, E. (2017). Fathers' feeding practices and children's weight status in Mexican American families. *Appetite, 117*, 109-116. https://doi.org/10.1016/j.appet.2017.06.016
Pew Research Center. (2015). *Parenting in America: Outlook, worries, aspirations are strongly linked to financial situation*. Retrieved January 2, 2020 from https://www.pewresearch.org/social-trends/2015/12/17/1-the-american-family-today/
Reedy, J., Lerman, J. L., Krebs-Smith, S. M., Kirkpatrick, S. I., Pannucci, T. E., Wilson, M. M., Subar, A. F., Kahle, L. L., & Tooze, J. A. (2018). Evaluation of the Healthy Eating Index-2015. *Journal of the Academy of Nutrition and Dietetics, 118*(9), 1622-1633. https://doi.org/10.1016/j.jand.2018.05.019
Shloim, N., Edelson, L. R., Martin, N., & Hetherington, M. M. (2015). Parenting Styles, Feeding Styles, Feeding Practices, and Weight Status in 4-12 Year-Old Children: A Systematic Review of the Literature. *Front Psychol, 6*, 1849. https://doi.org/10.3389/fpsyg.2015.01849
Simmonds, M., Burch, J., Llewellyn, A., Griffiths, C., Yang, H., Owen, C., Duffy, S., & Woolacott, N. (2015). The use of measures of obesity in childhood for predicting obesity and the development of obesity-related diseases in adulthood: a systematic review and meta-analysis. *Health Technol Assess, 19*(43), 1-336. https://doi.org/10.3310/hta19430

Spronk, I., Kullen, C., Burdon, C., & O'Connor, H. (2014). Relationship between nutrition knowledge and dietary intake. *Br J Nutr*, *111*(10), 1713-1726. https://doi.org/10.1017/s0007114514000087

Stahlschmidt, M. J., Threlfall, J., Seay, K. D., Lewis, E. M., & Kohl, P. L. (2013). Recruiting Fathers to Parenting Programs: Advice from Dads and Fatherhood Program Providers. *Child Youth Serv Rev*, *35*(10), 1734-1741. https://doi.org/10.1016/j.childyouth.2013.07.004

Thompson, F. E., Dixit-Joshi, S., Potischman, N., Dodd, K. W., Kirkpatrick, S. I., Kushi, L. H., Alexander, G. L., Coleman, L. A., Zimmerman, T. P., Sundaram, M. E., Clancy, H. A., Groesbeck, M., Douglass, D., George, S. M., Schap, T. E., & Subar, A. F. (2015). Comparison of Interviewer-Administered and Automated Self-Administered 24-Hour Dietary Recalls in 3 Diverse Integrated Health Systems. *Am J Epidemiol*, *181*(12), 970-978. https://doi.org/10.1093/aje/kwu467

Trakman, G. L., Forsyth, A., Devlin, B. L., & Belski, R. (2016). A Systematic Review of Athletes' and Coaches' Nutrition Knowledge and Reflections on the Quality of Current Nutrition Knowledge Measures. *Nutrients*, *8*(9). https://doi.org/10.3390/nu8090570

Tudge, J. R. H., Mokrova, I., Hatfield, B. E., & Karnik, R. B. (2009). Uses and Misuses of Bronfenbrenner's Bioecological Theory of Human Development. *JOURNAL OF FAMILY THEORY AND REVIEW*, *1*(4), 198-210.

U.S. Census Bureau. (2020). *Quick Facts*. Retrieved January 13, 2020 from https://www.census.gov/quickfacts/fact/table/guilfordcountynorthcarolina,NC,US

USDA. (2021, September 8, 2021). *Key Statistics & Graphics*. Economic Research Service. Retrieved September 14, 2021 from https://www.ers.usda.gov/topics/food-nutrition-assistance/food-security-in-the-us/key-statistics-graphics.aspx#map

USDA Food and Nutrition Service. (2013). *Healthy, Hunger-Free Kids Act*. Retrieved September 22, 2021 from https://www.fns.usda.gov/cn/healthy-hunger-free-kids-act

USDA Food and Nutrition Service. (2019). *HEI scores for Americans.* U.S. Deptartment of Agriculture. Retrieved September 10, 2021 from https://www.fns.usda.gov/hei-scores-americans

van der Horst, K., Oenema, A., Ferreira, I., Wendel-Vos, W., Giskes, K., van Lenthe, F., & Brug, J. (2006). A systematic review of environmental correlates of obesity-related dietary behaviors in youth. *Health Education Research*, *22*(2), 203-226. https://doi.org/10.1093/her/cyl069

Variyam, J. N. (2001). Overweight children: Is parental nutrition knowledge a factor? *FoodReview*, *24*(2), 18-22.

Vaughn, A. E., Ward, D. S., Fisher, J. O., Faith, M. S., Hughes, S. O., Kremers, S. P., Musher-Eizenman, D. R., O'Connor, T. M., Patrick, H., & Power, T. G. (2016). Fundamental constructs in food parenting practices: a content map to guide future research. *Nutr Rev*, *74*(2), 98-117. https://doi.org/10.1093/nutrit/nuv061

Vollmer, R. L., Adamsons, K., Gorin, A., Foster, J. S., & Mobley, A. R. (2015). Investigating the Relationship of Body Mass Index, Diet Quality, and Physical Activity Level between Fathers and Their Preschool-Aged Children. *J Acad Nutr Diet*, *115*(6), 919-926. https://doi.org/10.1016/j.jand.2014.12.003

Vollmer, R. L., & Mobley, A. R. (2013). Parenting styles, feeding styles, and their influence on child obesogenic behaviors and body weight. A review. *Appetite*, *71*, 232-241. https://doi.org/10.1016/j.appet.2013.08.015

Vollmer, R. L., & Mobley, A. R. (2017). Comparing Low-income Mothers' and Fathers' Concern for Young Children's Weight. *J Pediatr Nurs*, *37*, 97-100. https://doi.org/10.1016/j.pedn.2017.08.017

Whitaker, R. C., Wright, J. A., Pepe, M. S., Seidel, K. D., & Dietz, W. H. (1997). Predicting obesity in young adulthood from childhood and parental obesity. *N Engl J Med*, *337*(13), 869-873. https://doi.org/10.1056/nejm199709253371301

Yogman, M., & Garfield, C. F. (2016). Fathers' Roles in the Care and Development of Their Children: The Role of Pediatricians. *Pediatrics*, *138*(1). https://doi.org/10.1542/peds.2016-1128

APPENDIX A: FATHER CONSENT: ONLINE SURVEY

What are some general things you should know about research studies?
You are being asked to take part in a research study. Your participation in this study is voluntary. You may choose not to join, or you may withdraw your consent to be in the study, for any reason, without penalty.

Research studies are designed to obtain new knowledge. This new information may help people in the future. There may not be any direct benefit to you for being in the research study. There also may be risks to being in research studies. If you choose not to be in the study or leave the study before it is done, it will not affect your relationship with the researcher or the University of North Carolina at Greensboro.

Details about this study are discussed in this consent form. It is important that you understand this information so that you can make an informed choice about being in this research study.

What is the study about?
This is a research project. Your participation is voluntary. This study seeks to collect insights into the nutrition knowledge and child feeding styles and behaviors of Guilford County, NC fathers of children aged 6-11 years old. We seek to use this information to add to the body of knowledge about father's roles in feeding children and also to potentially develop nutrition education for fathers.

Why are you asking me?
We are asking you to participate as you are a Guilford County, NC resident and a father who parents a child aged 6 – 11 years old.

What will you ask me to do if I agree to be in the study?
We are asking you to complete the survey that follows. This survey is estimated to take 15 – 20 minutes of your time. You will also be asked to provide your email address if you are interested in participating in the second phase of the study- the online father diet quality assessment, and/or the third phase of the study - father focus groups to assess nutrition education needs and wants. The second phase of the study will collect information about your dietary intake. You will be asked to participate in a 3-day 24-hour diet recall, completed online, which will collect information about the foods and beverages you ate and drank.

What are the risks to me?
The Institutional Review Board at the University of North Carolina at Greensboro has determined that participation in this study poses minimal risk to participants. Emotional distress and/or embarrassment may be experienced on a rare basis by some participants. Questions relating to participant and child self-reported weight status and questions related to parenting will be requested. Questions to assess the impact of the COVID-19 pandemic and family stressors may also result in embarrassment and distress around ongoing concerns at the time of the survey. To protect the confidentiality of your responses, all participant data will be de-identified to ensure confidentiality

If you have questions, want more information, or have suggestions, please contact:

Principal Investigator:
Tina Irrer, PhD student, UNCG Department of Nutrition
jeirrer@uncg.edu

Faculty Advisor:
Dr. Lauren Haldeman, PhD, UNCG Professor and Director of Undergraduate Studies, Dept. of Nutrition
lahaldem@uncg.edu
If you have any concerns about your rights, how you are being treated, concerns or complaints about this project or benefits or risks associated with being in this study please contact the Office of Research Integrity at UNCG toll-free at (855)-251-2351.

Are there any benefits to society as a result of me taking part in this research?
It is our goal that this research will contribute to nutrition education for families that includes information and strategies that fathers can use to positively influence the long-term health of their child.

Are there any benefits to *me* for taking part in this research study?
There are no direct benefits to participants in this study.

Will I get paid for being in the study? Will it cost me anything?
Upon full completion of the survey, you will receive a $10 gift card which will be emailed to the email address you provide below. There are no costs to you.

How will you keep my information confidential?
Results of the survey will be reported in aggregate form only, without identifying any individual. All information obtained in this study is strictly confidential unless disclosure is required by law. Participants will be assigned code numbers and only those code numbers will be included on the Qualtrics survey and database files. No identifying information will be collected in the survey. Absolute confidentiality of data provided through the Internet cannot be guaranteed due to the limited protections of Internet access. Please be sure to close your browser when finished so no one will be able to see what you have been doing.

All of our participants' de-identified data will be kept indefinitely and will be posted to an online repository so other scientists can analyze the data and check our results. All collected data will be stored in a password protected UNCG Box account. No data files containing identifying information will be emailed or otherwise transmitted via the internet.

What if I want to leave the study?
You have the right to refuse to participate or to withdraw at any time, without penalty. If you do withdraw, it will not affect you in any way. If you choose to withdraw, you may request that any of your data which has been collected be destroyed unless it is in a de-identifiable state. The investigators also have the right to stop your participation at any time. This could be because you have had an unexpected reaction, or have failed to follow instructions, or because the entire study has been stopped.

What about new information/changes in the study?
If significant new information relating to the study becomes available which may relate to your willingness to continue to participate, this information will be provided to you.

Voluntary Consent by Participant:
By completing this survey, you are agreeing that you have read and fully understand the contents of this document and are willing to consent to take part in this study. All of your questions concerning this study have been answered.

By checking the box below, you are agreeing that you are 18 years of age or older and are agreeing to participate, in this study.

☐

My phone number is: (xxx-xxx-xxxx) _____

My email address is: _____

My address is:
_____
_____

My NC county of residence is: _____

I herein consent as described by the details above. Today's Date: _____

APPENDIX B: ONLINE SURVEY

1.1 I have at least one child 6 - 11 years old.

- ○ Yes (1)
- ○ No (2)

Skip To: End of Survey If I have at least one child 6 - 11 years old. = No

Q1.2 I am a North Carolina resident.

- ○ Yes (23)
- ○ No (24)

Q1.3 Please enter the age of your 6 -11-year-old child below as a whole number. *If you have more than one child in this age group, please select the* ***youngest child in this age range. When answering questions for the rest of this survey, please answer in reference to your youngest child in the 6–11-year-old age range.***

_____

Q1.4 My 6 -11-year-old child's sex is:

- ○ Male (1)
- ○ Female (2)

Q1.5 My 6 -11-year-old child lives with me:

- ○ All of the time (1)
- ○ About half the time (2)
- ○ Less than 8 days in a month (3)

Q1.6 Please tell us whether you are the biological father or non-biological father of the 6 -11-year-old child.

- ○ I am the biological father of this child (1)
- ○ I am related to this child (grandparent, uncle, adult brother) (2)
- ○ I am the non-biological father of this child (foster father, adopted father, stepfather) (3)

Q1.7 For these next two questions, please record your child's most recent height and weight which were measured during the most recent visit to your child's doctor. **Please login to your child's online patient portal to find this information.** *For example, if your child's doctor is a member of the Cone Health Medical Group, you will login to the "MyChart Cone Health" patient portal and enter the MyChart username and password associated with your child's patient records.*

Q1.8 Please type in the box below your child's most recent recorded height in feet and inches. *For example, if your child's height is 4 feet 3 inches, please enter **4, 3**.*

_____

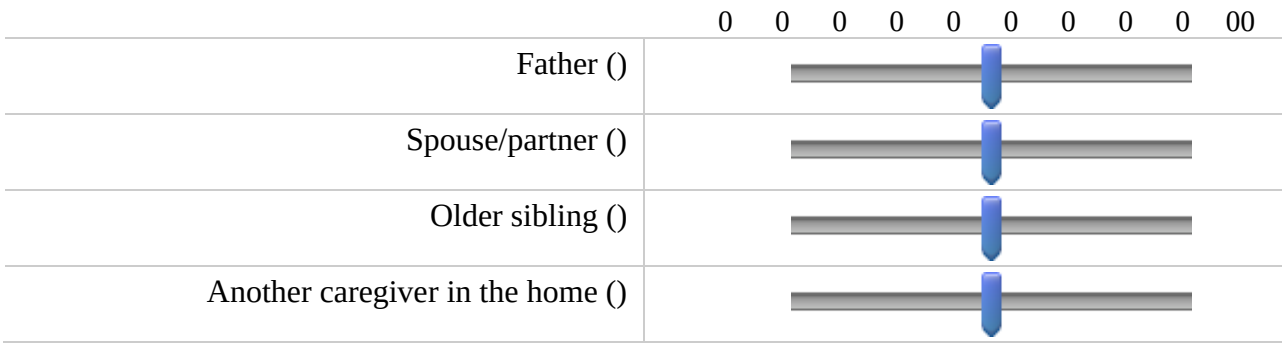
Q1.9 Please type in the box below your child's most recent recorded weight in pounds as a whole number. *For example, if your child's most recent weight was 72 pounds, please enter 7**2**.*

_____

End of Block: Introduction

Start of Block: Please tell us about feeding your 6 -11-year-old child.

Q2.1 When your 6 -11-year-old child is at home/in your home - how often are you or another person responsible for feeding him/her? *Please use the percentage slider bar below to indicate the estimated time per person.*



Q2.2 Compared to your spouse/partner, how would you say you share in feeding responsibilities for your 6–11-year-old child? *Feeding responsibilities includes planning meals, shopping for foods items, preparing meals, serving meals.*

- Mostly or always my spouse/partner (2)
- Sometimes my spouse/partner (5)
- We share feeding responsibilities equally (6)
- Sometimes me (7)
- Mostly or always me (8)

Q2.3 How often are *you* responsible for deciding portion sizes for meals and snacks for your 6 -11-year-old child?

- ○ Never (1)
- ○ Sometimes (2)
- ○ About half the time (3)
- ○ Most of the time (4)
- ○ Always (5)

Q2.4 How often are *you* responsible for deciding if your 6 -11-year-old child has eaten the right kind of foods?

- ○ Never (1)
- ○ Sometimes (2)
- ○ About half the time (3)
- ○ Most of the time (4)
- ○ Always (5)

Q2.5 I have to be sure my 6 -11-year-old child does not eat too many sweets. *Sweets includes foods such as soft drinks, candy, ice cream, cookies, cake, pastries.*

- ○ Disagree (1)
- ○ Somewhat disagree (2)
- ○ Neither agree nor disagree (3)
- ○ Somewhat agree (4)
- ○ Agree (5)

Q2.6 I have to be sure my 6 -11-year-old child does not eat too many high-fat foods. *High-fat foods include foods that are high in saturated fats, such as French fries, hot dogs, fried chicken, bacon, ice cream, pastries, donuts, cakes, cookies.*

- ○ Disagree (1)
- ○ Somewhat disagree (2)
- ○ Neither agree nor disagree (3)
- ○ Somewhat agree (4)
- ○ Agree (5)

Q2.7 If I do not guide or regulate my 6 -11-year-old child's eating, he/she will eat too many junk foods. *Junk foods include foods that are higher in calories, usually from sugar and/or fat, and lower in nutritional content. Examples of junk foods include fast food items - such as tacos, milk shakes, French fries, fried chicken nuggets and sandwiches, pizza; also, potato and corn chips, candy, sugary carbonated beverages, sweet desserts.*

- ○ Disagree (1)
- ○ Somewhat disagree (2)
- ○ Neither agree nor disagree (3)
- ○ Somewhat agree (4)
- ○ Agree (5)

Q2.8 I keep some foods out of my 6 -11-year-old child's reach on purpose.

- ○ Disagree (1)
- ○ Somewhat disagree (2)
- ○ Neither agree nor disagree (3)
- ○ Somewhat agree (4)
- ○ Agree (5)

Q2.9 I offer sweets (candy, cookies, ice cream, etc.) to my 6 -11-year-old child as a reward for good behavior.

- ○ Disagree (1)
- ○ Somewhat disagree (2)
- ○ Neither agree nor disagree (3)
- ○ Somewhat agree (4)
- ○ Agree (5)

Q2.10 My 6 - 11-year-old child should always eat *all* the food on his/her plate.

- ○ Disagree (1)
- ○ Somewhat disagree (2)
- ○ Neither agree nor disagree (3)
- ○ Somewhat agree (4)
- ○ Agree (5)

Q2.11 I have to be careful to make sure my 6 -11-year-old child eats enough.

- ○ Disagree (1)
- ○ Somewhat disagree (2)
- ○ Neither agree nor disagree (3)
- ○ Somewhat agree (4)
- ○ Agree (5)

Q2.12 If my 6 -11-year-old child says, "*I'm not hungry*", I try to get him/her to eat anyway.

- ○ Disagree (1)
- ○ Somewhat disagree (2)
- ○ Neither agree nor disagree (3)
- ○ Somewhat agree (4)
- ○ Agree (5)

Q2.13 If I did not guide or regulate my 6 -11-year-old child's eating, he/she would eat more than he/she should.

- ○ Disagree (1)
- ○ Somewhat disagree (2)
- ○ Neither agree nor disagree (3)
- ○ Somewhat agree (4)
- ○ Agree (5)

Q2.14 How concerned are you about your child eating too much when you are not around him/her?

- ○ Unconcerned (1)
- ○ A little concerned (2)
- ○ Concerned (3)

Q2.15 How concerned are you about your child becoming overweight?

- ○ Unconcerned (1)
- ○ A little concerned (2)
- ○ Concerned (3)

Q2.16 Please select how closely you agree or disagree with each statement (please select one choice per statement).

	Disagree (295)	Somewhat disagree (296)	Neither disagree nor agree (297)	Somewhat agree (298)	Agree (299)
I can prepare fruit that my child will eat. (1)	○	○	○	○	○
If I include fruit as part of a meal, my child will eat the fruit. (10)	○	○	○	○	○
If I give my child fruit for a snack, my child will eat the fruit. (8)	○	○	○	○	○
I can prepare vegetables that my child will eat. (2)	○	○	○	○	○
If I include vegetables as part of a	○	○	○	○	○

meal, my child will eat the vegetables. (27)					
If I give my child vegetables for a snack, my child will eat the vegetables. (9)	○	○	○	○	○
I can prepare a recipe with my child. (25)	○	○	○	○	○
If I prepare a meal together with my child, my child will eat the meal. (26)	○	○	○	○	○

End of Block: Please tell us about feeding your 6 -11-year-old child.

Start of Block: Please tell us more about yourself and your family.

Q3.1 My primary work setting is:

- ○ Alamance Regional Medical Center (1)
- ○ Annie Penn Hospital (2)
- ○ Behavioral Health Hospital (3)
- ○ Moses Cone Hospital (4)
- ○ Wesley Long Hospital (5)
- ○ Another Cone Health location (6)
- ○ None of the above - I am the significant other or friend of a Cone Health employee and do NOT work at Cone Health (7)

Q3.2 My work department is best described as:

- ○ Nursing (1)
- ○ Non-nursing (2)
- ○ None of the above - I am the significant other or friend of a Cone Health employee and do NOT work at Cone Health (3)

Q3.3 Does your or your child's household of residence receive benefits from SNAP (Supplemental Nutrition Assistance Program - formerly food stamps)?

- ○ Yes (1)
- ○ No (2)

Q3.4 Does your or your child's household of residence receive benefits from WIC (Women, Infants and Children)?

- ○ Yes (1)
- ○ No (2)

Q3.5 Please review the following statement: "The food that (I/we) bought just did not last, and (I/we) did not have money to get more." Was that often, sometimes, or never true for (you/your household) in the last 12 months?

- ○ Often true (1)
- ○ Sometimes true (2)
- ○ Never true (3)

Q3.6 Please review the following statement: "(I/we) could not afford to eat balanced meals." Was that often, sometimes, or never true for (you/your household) in the last 12 months?

- ○ Often true (1)
- ○ Sometimes true (2)
- ○ Never true (3)

Q3.7 In the last 12 months, did (you/you or other adults in your household) ever cut the size of your meals or skip meals because there was not enough money for food?

- ○ Yes (1)
- ○ No (2)

Skip To: Q3.9 If in the last 12 months, did (you/you or other adults in your household) ever cut the size of your... = No

Q3.8 How often did this happen— almost every month, *some months* but not every month, or in only 1 or 2 months?

- ○ Almost every month (1)
- ○ Some months, but not every month (2)
- ○ Only 1 or 2 months (3)

Q3.9 In the last 12 months, did you ever eat less than you felt you should because there was not enough money for food?

- ○ Yes (1)
- ○ No (2)

Q3.10 In the last 12 months, were you ever hungry but did not eat because there was not enough money for food?

- ○ Yes (1)
- ○ No (2)

Q3.11 Does anyone in your household follow a special diet for medical purposes, such as for diabetes?

- ○ Yes (1)
- ○ No (2)

Skip To: Q3.13 If Does anyone in your household follow a special diet for medical purposes, such as for diabetes? = No

Q3.12 Who follows a special diet in your household for medical purposes?

- ○ Child aged 6-11 years old (1)
- ○ Another child in the household (2)
- ○ Spouse/partner (3)
- ○ Father (4)
- ○ Another household resident (5)

Q3.13 What is your marital status?

- ○ Married (1)
- ○ Not married but living together with a partner (2)
- ○ Single (3)
- ○ Separated (4)
- ○ Divorced (5)
- ○ Widowed (6)

Q3.14 How many children 18 years old or younger are in your household:

- ○ 1 (1)
- ○ 2 (2)
- ○ 3 (3)
- ○ 4 (4)
- ○ There are more than 4 children in my household (5)
- ○ My child/children do not live with me (6)

Q3.15 Please tell us your age (please enter a whole number such as 32):

_____

Q3.16 Please tell us your height in feet and inches. *For example, if you are 6 feet 2 inches tall enter* **6, 2**

_____

Q3.17 Please tell us your weight in pounds as a whole number. *For example, if you weigh 180.2 pounds, please enter* **180**.

_____

Q3.18 What is your race?

- White (1)
- African American/Black (2)
- Native American or Alaska Native (3)
- Asian (4)
- Native Hawaiian or Pacific Islander (5)
- Other/multiracial (6)

Q3.19 What is your ethnicity?

- Hispanic or Latino (1)
- Non-Hispanic or Non-Latino (2)

Q3.20 What is your highest level of education?

- High school or less (1)
- Some college (2)
- Vocational school (3)
- Associate degree (4)
- Bachelor's degree (5)
- Graduate degree (for example master's, professional, doctorate) (6)

Q3.21 What is your employment status?

- ○ Not employed (1)
- ○ Work outside the home part-time (2)
- ○ Work outside the home full-time (3)
- ○ Employed part-time, work from home (4)
- ○ Employed full-time, work from home (5)

Q3.22 What is your wife's/partner's employment status?

- ○ Not employed (1)
- ○ Work outside the home part-time (2)
- ○ Work outside the home full-time (3)
- ○ Employed part-time, work from home (4)
- ○ Employed full-time, work from home (5)
- ○ I live alone (6)

Q3.23 What is your household income?

- Less than $15,000 (1)
- $15,000 to $24,999 (2)
- $25,000 to $34,999 (3)
- $35,000 to $49,999 (4)
- $50,000 - $74,999 (5)
- more than $75,000 (6)

Q3.24 *Please indicate how much you agree with the following statements*. My family has enough money to afford the kind of:

	Disagree (18)	Somewh at disagree (19)	Neither agree nor disagree (20)	Somewh at agree (21)	Agree (22)
Home we would like to have (1)	○	○	○	○	○
Clothing we should have (2)	○	○	○	○	○
Furniture or household equipment we should have (3)	○	○	○	○	○
Car we should have (4)	○	○	○	○	○
Food we should have (5)	○	○	○	○	○
Medical care we should have (6)	○	○	○	○	○
Leisure and recreational activities we want to participate in (7)	○	○	○	○	○
Our income never seems to catch up with our expenses (8)	○	○	○	○	○

Q3.25 There are people I can depend on to help me if I really need it.

- ○ Strongly agree (19)
- ○ Agree (20)
- ○ Disagree (21)
- ○ Strongly disagree (22)

Q3.26 There are people who enjoy the same social activities I do.

- ○ Strongly agree (1)
- ○ Agree (2)
- ○ Disagree (3)
- ○ Strongly disagree (4)

Q3.27 I have close relationships that provide me with a sense of emotional security and well-being.

- ○ Strongly agree (1)
- ○ Agree (2)
- ○ Disagree (3)
- ○ Strongly disagree (4)

Q3.28 There is someone I could talk to about important decisions in my life.

- ○ Strongly agree (1)
- ○ Agree (2)
- ○ Disagree (3)
- ○ Strongly disagree (4)

Q3.29 I have relationships where my competence and skill are recognized.

- ○ Strongly agree (1)
- ○ Agree (2)
- ○ Disagree (3)
- ○ Strongly disagree (4)

Q3.30 There is trustworthy person I could turn to for advice if I were having problems.

- ○ Strongly agree (1)
- ○ Agree (2)
- ○ Disagree (3)
- ○ Strongly disagree (4)

Q3.31 I feel part of a groups of people who share my attitudes and beliefs.

- ○ Strongly agree (1)
- ○ Agree (2)
- ○ Disagree (3)

- ○ Strongly disagree (4)

Q3.32 I feel a strong emotional bond with at least one other person.

- ○ Strongly agree (1)
- ○ Agree (2)
- ○ Disagree (3)
- ○ Strongly disagree (8)

Q3.33 There are people who admire my talents and abilities.

- ○ Strongly agree (1)
- ○ Agree (2)
- ○ Disagree (3)
- ○ Strongly disagree (4)

Q3.34 There are people I can count on in an emergency.

- ○ Strongly agree (8)
- ○ Agree (9)
- ○ Disagree (10)
- ○ Strongly disagree (11)

End of Block: Please tell us more about yourself and your family.

Start of Block: Please tell us how the COVID-19 pandemic has impacted you and your family.

Q4.1 Have you, or has anyone in your household experienced a loss of employment income **since the beginning of COVID-19 restrictions** (March 13, 2020)?

- ○ Yes (1)
- ○ No (2)

Skip To: Q4.3 If Have you, or has anyone in your household experienced a loss of employment income since the begin... = No

Q4.2 What was the main reason for not working/loss of employment? *Please select only one answer.*

- ○ Did not want to be employed at this time (1)
- ○ Did not work because of sickness with COVID-19 symptoms (2)
- ○ Did not work because needed to care for someone with COVID-19 symptoms (3)
- ○ Did not work because needed to care for children not in school or daycare (4)
- ○ Did not work because needed to care for an elderly person (5)
- ○ Did not work due to illness or disability (not COVID-19 related) (6)
- ○ Did not work due to retirement (7)
- ○ Did not have work due to COVID-19 pandemic related reduction in business (including furlough) (8)
- ○ Did not work due to being laid off due to COVID-19 pandemic (9)
- ○ Employment closed temporarily due to the COVID-19 pandemic (10)
- ○ Employment went out of business due to the COVID-19 pandemic (11)

Q4.3 If you continued to work **since the beginning of the COVID-19 restrictions** (March 13, 2020), did you begin working mostly from home instead of your regular work location?

- ○ Yes (1)
- ○ No (2)
- ○ I did not continue paid work (5)

Q4.4 If your spouse/partner continued to work **since the beginning of the COVID-19 restrictions** (March 13, 2020), did your spouse/partner begin working mostly from home instead of their regular work location?

- ○ Yes (1)
- ○ No (2)
- ○ My spouse/partner did not continue paid work (3)
- ○ I live alone (4)

Q4.5 Getting enough food is a problem for some people/families. Which of these statements best describes the food eaten in your household **since the beginning of COVID-19 restrictions** (March 13, 2020)? *Please select only one answer.*

- ○ We had enough of the kinds of food (I/we) wanted to eat (1)
- ○ We had enough, but not always the kinds of food (I/we) wanted to eat (2)
- ○ We sometimes did not have enough to eat (3)
- ○ We often did not have enough to eat (4)

Q4.6 In the **last 7 days**, which of these statements best describes the food eaten in your household? *Please select only one answer.*

- ○ We had enough of the kinds of food (I/we) wanted to eat (1)
- ○ We had enough, but not always the kinds of food (I/we) wanted to eat (2)
- ○ We sometimes did not have enough to eat (3)
- ○ We often do not have enough to eat (4)

Skip To: Q4.8 If In the last 7 days, which of these statements best describes the food eaten in your household? P... = We had enough of the kinds of food (I/we) wanted to eat

Q4.7 In the **last 7 days**, why did you/your family not have enough to eat or not what you/your family wanted to eat? *Please choose all that apply.*

- ☐ Couldn't afford to buy more food (1)
- ☐ Couldn't get out to buy food (for example, didn't have transportation, or had mobility or health problems that prevented you from getting out) (2)
- ☐ Concerned about going out or didn't want to go out to buy food (3)
- ☐ Couldn't get groceries or meals delivered to my home (4)
- ☐ The stores didn't have the food I/we wanted (5)

Q4.8 During the **last 7 days**, did you or anyone in your household get free groceries or a free meal? *Please select only one answer.*

- ○ Yes (1)
- ○ No (2)

Skip To: Q4.10 If During the last 7 days, did you or anyone in your household get free groceries or a free meal? Pl... = No

Q4.9 In the **last 7 days**, where did you get free groceries or free meals? *Please choose all that apply.*

- ☐ Free meals through the school or other programs aimed at children (1)
- ☐ Food pantry or food bank (2)
- ☐ Church, synagogue, temple, mosque or other religious organization (3)
- ☐ Shelter or soup kitchen (4)
- ☐ Other community program (5)
- ☐ Family, friends, or neighbors (6)

Q4.10 Please indicate if any of the listed events have impacted you **since the beginning of COVID-19 restrictions** (March 13, 2020). <u>These could be events that are related or unrelated to</u>

COVID-19. Then, for any item that did impact you, *please indicate how much the event affected you - a little or a lot).*

	Did not affect me (1)	Yes, it affected me a little (2)	Yes, it affected me a lot (17)
You were admitted to the hospital. (1)	○	○	○
You had a serious accident or illness. (2)	○	○	○
Your partner had a serious accident or illness. (3)	○	○	○
A friend/family member had a serious accident/illness. (4)	○	○	○
Your partner died. (13)	○	○	○
A friend or relative died. (14)	○	○	○
You experienced a significant drop in income. (9)	○	○	○
You had trouble paying your bills (10)	○	○	○
You became homeless. (12)	○	○	○
You moved or changed residence (15)	○	○	○
You started living with your partner (21)	○	○	○
A friend/family member moved in (18)	○	○	○

A friend/family member moved out (19)	○	○	○
You got married (20)	○	○	○
You were separated/divorced. (7)	○	○	○
You started a new job (16)	○	○	○
You had serious problems with childcare (17)	○	○	○

Q4.11 Please indicate if the following family meal behaviors have not changed, some change or a lot of change **since the beginning of COVID-19 restrictions** (March 13, 2020).

	No change (2)	Some change (5)	A lot of change (6)
How often we eat meals together in the household (1)	○	○	○
How often I eat breakfast with my 6 - 11-year-old child (6)	○	○	○
How often I eat lunch with my 6 -11-year-old child (7)	○	○	○
How often I eat dinner with my 6 -11-year-old child (8)	○	○	○
How often I eat snacks with my 6 -11-year-old child (9)	○	○	○
My involvement in feeding my 6 -11-year-old child (2)	○	○	○
My participation in preparing meals (3)	○	○	○
My participation in shopping for meals (4)	○	○	○
My involvement in monitoring what my 6 -11-year-old child eats for meals and snacks. (5)	○	○	○

Q4.12 The COVID-19 pandemic has impacted delivery of education for many children. Please indicate where your 6–11-year-old child is currently learning:

- ○ At home (1)
- ○ At school (2)
- ○ Hybrid (3)

End of Block: Please tell us how the COVID-19 pandemic has impacted you and your family.

Start of Block: These next few questions are about your nutrition knowledge.

Q5.1 Do you think health experts recommend that people should be eating more, the same amount, or less of the following foods? *Please select one answer per food item.*

	More (1)	Same (2)	Less (3)
Vegetables (1)	○	○	○
Sugary foods (2)	○	○	○
Meat (3)	○	○	○
Starchy foods (4)	○	○	○
Fatty foods (5)	○	○	○
High fiber foods (6)	○	○	○
Fruit (7)	○	○	○
Salty foods (8)	○	○	○

Q5.2 How many servings of fruit and vegetables a day do you think experts recommend people eat? *For example, one serving could be an apple or a handful of chopped carrots.*

- ○ 1 (1)
- ○ 2 (2)
- ○ 3 (3)
- ○ 4 (4)
- ○ 5 (5)
- ○ 6 (6)
- ○ More than 6 (7)

Q5.3 Which type of fat do health experts say is most important for people to cut down on? *Please select one choice.*

- ○ Monounsaturated fat (1)
- ○ Polyunsaturated fat (2)
- ○ Saturated fat (3)
- ○ Not sure (4)

Q5.4 Please review the following listed foods. Do you think these foods are high or low in ADDED sugar? *Please select one choice per food item.*

	High in added sugar (1)	Low in added sugar (2)	Not sure (3)
Bananas (1)	○	○	○
Flavored yogurt (2)	○	○	○
Cereal bars/protein bars (3)	○	○	○
Juice drinks (4)	○	○	○
Fresh strawberries (5)	○	○	○
Fruit chew snacks (6)	○	○	○
Watermelon (7)	○	○	○

Q5.5 When choosing foods for your child aged 6 - 11 years old, how important are the following factors when making the food decision. *Please rank whether the factor is important, somewhat important, or not at all important.*

	Important (1)	Somewhat important (2)	Not at all important (3)
Taste (1)	○	○	○
Cost (2)	○	○	○
Disease prevention (3)	○	○	○
Speed (4)	○	○	○
Convenience (5)	○	○	○
Health (6)	○	○	○
Weight control (7)	○	○	○

Q5.6 A healthy meal/plate should consist of half meat, a quarter vegetable and a quarter grain (*such as potatoes, rice, or pasta*).

- ○ Agree (1)
- ○ Disagree (2)
- ○ Not sure (3)

End of Block: These next few questions are about your nutrition knowledge.

Start of Block: These last few questions are about your food parenting behaviors.

Q6.1 Please select how frequently you have done each item during the past week. *Please select one choice per statement.*

	Never (0 days) (1)	Sometimes (1-3 days) (2)	Often (4-6 days) (3)	Always (7 days) (4)
How often do you eat breakfast with your child? (1)	○	○	○	○
How often do you eat fruit at breakfast with your child? (2)	○	○	○	○
How often do you eat lunch with your child? (3)	○	○	○	○
How often do you eat vegetables at lunch with your child? (4)	○	○	○	○
How often do you eat fruit at lunch with your child? (5)	○	○	○	○
How often do you eat dinner with your child? (6)	○	○	○	○
How often do you eat vegetables at dinner with your child? (7)	○	○	○	○
How often do you eat fruit at dinner with your child? (8)	○	○	○	○

How often do you eat a snack with your child? (9)	○	○	○	○
How often do you eat vegetables as a snack with your child? (10)	○	○	○	○
How often do you eat fruit as a snack with your child? (11)	○	○	○	○

Q6.2 You compliment your child after he/she has done something well.

- ○ Never (1)
- ○ Sometimes (2)
- ○ About half the time (3)
- ○ Most of the time (4)
- ○ Always (5)

Q6.3 Please enter today's date below: (mm/dd/yyyy - for example: 09/10/2020)

_____

End of Block: These last few questions are about your food parenting behaviors.

Start of Block: Thank you!

Q7.1

Thank you very much for your responses to our survey. We greatly appreciate your time.

There are two more phases of this research related to fathers of children aged 6 -11 years old.

The second phase will capture fathers' food intake using an online survey tool. The third phase will be small, online discussion groups to talk about fathers' nutrition education needs, nutrition topics of interest, and the best way to deliver education topics and education.

For more information about participation in the diet survey and discussion groups, please enter your email below:

_____

APPENDIX C: ADDITIONAL QUESTIONS FOR THE HEALTHCARE ORGANIZATION EMPLOYEE SURVEY

Q3.1 My primary work setting is:

- ○ Alamance Regional Medical Center (1)
- ○ Annie Penn Hospital (2)
- ○ Behavioral Health Hospital (3)
- ○ Moses Cone Hospital (4)
- ○ Wesley Long Hospital (5)
- ○ Another Cone Health location (6)
- ○ None of the above - I am the significant other or friend of a Cone Health employee and do NOT work at Cone Health (7)

Q3.2 My work department is best described as:

- ○ Nursing (1)
- ○ Non-nursing (2)
- ○ None of the above - I am the significant other or friend of a Cone Health employee and do NOT work at Cone Health (3)

APPENDIX D: FATHER CONSENT: ONLINE DIETARY DATA COLLECTION

(ASA24-2020)

Thank you for your continued support of the UNCG nutrition graduate student Father research study. We appreciate your willingness to participate in the dietary data collection portion of this study. You are being asked to provide details about the foods and beverages that you consumed for 2-days using the online NIH National Cancer Institute ASA24-2020 dietary assessment tool.

What are some general things you should know about research studies?
You are being asked to take part in a research study. Your participation in this study is voluntary. You may choose not to join, or you may withdraw your consent to be in the study, for any reason, without penalty.

Research studies are designed to obtain new knowledge. This new information may help people in the future. There may not be any direct benefit to you for being in the research study. There also may be risks to being in research studies. If you choose not to be in the study or leave the study before it is done, it will not affect your relationship with the researcher or the University of North Carolina at Greensboro.

Details about this study are discussed in this consent form. It is important that you understand this information so that you can make an informed choice about being in this research study.

What is the study about?
This is a research project. Your participation is voluntary. This study seeks to collect insights into the nutrition knowledge and child feeding styles and behaviors of North Carolina fathers of children aged 6-11 years old. We seek to use this information to add to the body of knowledge about father's roles in feeding children and also to potentially develop nutrition education for fathers.
Why are you asking me?
We are asking you to participate as you are a North Carolina resident and a father who parents a child aged 6 – 11 years old.
What will you ask me to do if I agree to be in the study?
We are asking you to complete the dietary intake survey that follows using the ASA24-2020 assessment tool. This dietary intake survey is estimated to take about 45 minutes of your time. You will also be asked to provide your email address if you are interested in participating in the third phase of the study- virtual father focus groups to assess nutrition education needs and wants.
What are the risks to me?
The Institutional Review Board at the University of North Carolina at Greensboro has determined that participation in this study poses minimal risk to participants. Emotional distress and/or embarrassment may be experienced on a rare basis by some participants. To protect the confidentiality of your responses, all participant data will be de-identified to ensure confidentiality.
Are there any benefits to society as a result of me taking part in this research?

It is our goal that this research will contribute to nutrition education for families that includes information and strategies that fathers can use to positively influence the long-term health of their child.

Are there any benefits to me for taking part in this research study?

The ASA24-2020 dietary assessment tool will generate a Respondent Nutrition Report (RNR). The RNR will provide you with feedback about how your reported dietary intake compares to the US dietary guidance for calorie, food group, and nutrient intake by your age and sex category.

Will I get paid for being in the study? Will it cost me anything?

Upon full completion of two, automated web-based 24-hour dietary recalls, you will be emailed an online $25 Amazon gift card. There are no costs to you.

How will you keep my information confidential?

Results of the survey will be reported in aggregate form only, without identifying any individual. All information obtained in this study is strictly confidential unless disclosure is required by law. Participants will be assigned code numbers and only those code numbers will be included in any database files. No identifying information will be collected in the diet survey and the ASA24-2020 system does not capture any personally identifiable data from participants.

The ASA24-2020 system will access the IP address information for the purpose of routing information between the server and the participant's computer -- often the IP address is that of the user's Internet Service Provider (ISP). IP addresses are not stored or tracked by the ASA24-2020 system. Absolute confidentiality of data provided through the Internet cannot be guaranteed due to the limited protections of Internet access. Please be sure to close your browser when finished so no one will be able to see what you have been doing.

All participant de-identified data will be kept indefinitely and will be posted to an online repository so other scientists can analyze the data and check our results. The de-identified data may be used for future research and may occur without obtaining additional consent. All collected data will be stored in a password protected UNCG Box account. No data files containing identifying information will be emailed or otherwise transmitted via the internet.

What if I want to leave the study?

You have the right to refuse to participate or to withdraw at any time, without penalty. If you do withdraw, it will not affect you in any way. If you choose to withdraw, you may request that any of your data which has been collected be destroyed unless it is in a de-identifiable state. The investigators also have the right to stop your participation at any time. This could be because you have had an unexpected reaction, or have failed to follow instructions, or because the entire study has been stopped.

What about new information/changes in the study?

If significant new information relating to the study becomes available which may relate to your willingness to continue to participate, this information will be provided to you.

If you have questions, want more information, or have suggestions, please contact:

Principal Investigator:
Tina Irrer, PhD student, UNCG Department of Nutrition
jeirrer@uncg.edu

Faculty Advisor:

Dr. Lauren Haldeman, PhD, UNCG Professor and Director of Undergraduate Studies, Dept. of Nutrition
lahaldem@uncg.edu

If you have any concerns about your rights, how you are being treated, concerns or complaints about this project or benefits or risks associated with being in this study please contact the Office of Research Integrity at UNCG toll-free at (855)-251-2351.

Voluntary Consent by Participant
By completing this diet data collection, you are agreeing that you have read and fully understand the contents of this document and are willing to consent to take part in this study. All of your questions concerning this study have been answered.

By clicking on "Yes, I agree to participate," you agree that you have read this informed consent agreement, you understand what is involved, and you are consenting to participate in this research study.

If you do not wish to participate, select "No, I do not wish to participate" to exit.

- o Yes, I agree to participate.
- o No, I do not wish to participate.

If you agree to participate, you will be asked to provide your name and email address. Upon confirmation of your consent to participate we will email you the logon credentials for the ASA24-2020 assessment tool.

APPENDIX E: SURVEY RECRUITMENT: CONE HEALTH

Dear Cone Health Employee,

We are seeking **fathers who have a child aged 6 – 11 years old and live in North Carolina** to participate in this important family research being conducted by UNCG along with Cone Health.

If you are not a North Carolina father of a child aged 6 -11 years old, but you know of someone who is (husband, relative, friend), please feel free to forward this email to them so that they may consider participation.

This study seeks to collect information about the nutrition knowledge and child feeding styles and behaviors of NC fathers of children aged 6-11 years old. We will use this information to add to the knowledge about fathers' roles in feeding children and also to potentially develop nutrition education for fathers. Your responses will contribute to the large gap that exists about fathers' roles in feeding their school-aged children.

This research has three phases: online survey, online father diet recall, and father focus groups to assess nutrition education needs and wants.

This email is to request your participation in this first phase of the study, the online survey. Your input in this first phase of this research is needed to add to the body of knowledge about the role fathers play in feeding their children.

Below is a link to the online survey which will take approximately 20 minutes to complete. You will first complete a consent form to participate in the survey. ***Please know that we value your privacy, and your responses will be anonymous.***

As a thank you for your completed survey, we will confirm your email address at the end so that we may email you a link for a $10 online gift card. We will also ask you to let us know If you would like to participate in the online father diet survey and/or the father education focus groups.

Thank you so much for your time and consideration! It is our hope that this research will contribute to nutrition education for families that includes information and strategies that fathers can use to positively influence the long-term health of their child.

Link to survey: https://uncg.qualtrics.com/jfe/form/SV_1GPNkyim2Y9ApO5

APPENDIX F: FOLLOW-UP SURVEY RECRUITMENT: CONE HEALTH

Dear Cone Health Employee,

Just in case you missed our email invitation a couple of weeks ago…If you have already responded, we thank you very much for your participation!

We are seeking **fathers who have a child aged 6 – 11 years old and live in Guilford County, NC** to participate in this important family research being conducted by UNCG along with Cone Health. *If you do not meet the criteria, but you know of someone who does (husband, relative, friend), please feel free to forward this email to them so that they may consider participation.*

This study seeks to collect information about the nutrition knowledge and child feeding styles and behaviors of Guilford County, NC fathers of children aged 6-11 years old. We will use this information to add to the body of knowledge about fathers' roles in feeding children and also to develop nutrition education for fathers. Your answers will contribute to the large gap that exists about fathers' roles in feeding their school-aged children.

This research consists of three phases: online survey, online father diet recall, and father focus groups to assess nutrition education needs and wants.

This email is to request your participation in this first phase of the study, the online survey. Your input in this first phase of this research is important to adding to the body of knowledge about the role fathers play in feeding their children.

Below is a link to the online survey which will take approximately 20 minutes to complete. You will first complete a consent form to participate in the survey. ***Please know that we value your privacy, and your responses will be anonymous.***

As a thank you for your completed survey, we will provide a $10 online gift card. If you would like to participate in the online father diet recall and/or the father education focus groups, you can indicate your level of interest at the end of the survey.

Thank you so much for your time and consideration! It is our hope that this research will contribute to nutrition education for families that includes information and strategies that fathers can use to positively influence the long-term health of their child.

APPENDIX G: SURVEY RECRUITMENT: UNCG

Dear fellow UNCG Spartan,

We are seeking **fathers who have a child aged 6 – 11 years old and live in North Carolina** to participate in this important family research being conducted by UNCG Department of Nutrition student, Tina Irrer, in partnership with Drs. Lauren Haldeman and Cheryl Buehler.

If you are not a North Carolina father of a child aged 6 -11 years old, but you know of someone who is (relative, neighbor, friend), please feel free to forward this email to them so that they may consider participation.

This study seeks to collect information about the nutrition knowledge and child feeding styles and behaviors of NC fathers of children aged 6-11 years old. We will use this information to add to the knowledge about fathers' roles in feeding children and to potentially develop nutrition education for fathers. Your responses will contribute to the large gap that exists about fathers' roles in feeding their school-aged children.

This research has three phases: online survey, online father diet recall, and father focus groups to assess nutrition education needs and wants.

This email is to request your participation in this **first phase of the study**, the online survey. Your input in this first phase of this research is needed to add to the body of knowledge about the role fathers play in feeding their children.

Below is a link to the online survey which will take approximately 20 minutes to complete. You will first complete a consent form to participate in the survey. ***Please know that we value your privacy, and your responses will be anonymous.***

As a thank you for your completed survey, we will confirm your email address at the end so that we may email you a link for a $10 online Amazon gift card. **We will also follow up and ask you to let us know If you would like to participate in the online father diet survey and/or the father education focus groups**.

Thank you so much for your time and consideration! It is our hope that this research will contribute to nutrition education for families that includes information and strategies that fathers can use to positively influence the long-term health of their child.

Link to consent and survey: https://uncg.qualtrics.com/jfe/form/SV_0wujyT6L2kCUrTE

survey link: https://uncg.qualtrics.com/jfe/form/SV_8quql5WFbSHTANw

APPENDIX H: FATHER DIET DATA COLLECTION RECRUITMENT

Hello NC Father,

Thank you for participating in the online, UNCG nutrition graduate student Father survey. Hopefully, you have received the online $10 Amazon gift card for participating in the online father survey. Please let us know if you had any issues with the link.

We are writing to ask you to participate in the **second phase of the study, the father diet assessment.** We are using the National Cancer Institute Automated Self-administered 24-hour Dietary Assessment tool – the **ASA24-2020**. If you would like to get more information about the tool – select Link to demo ASA24-2020 and then the "launch demo ASA24-2020" to review the dietary assessment tool.

The diet assessment using the **ASA24-2020** online tool can be completed at a time that is convenient for you. To participate, you will log into the ASA24-2020 tool on 2 separate days to input information about what you ate and drank the day before. We will ask you to provide information about what you ate for **2-days** – preferably **1 workday** (for example, Mon-Friday) and **1 weekend day** (a day you are not scheduled for work; for example, Saturday or Sunday). The average time for completion is 45-60 minutes to complete the surveys for the two days.

As a thank you for participating in the second phase of the study, we will email you a link for a $25 Amazon gift card upon completion of 2 diet surveys.

If you are interested in participation, please reply to this email and we will send you the participant consent, the participant quick start guide, and the login ID and password to begin.

Thank you very much for considering participation in this next phase of the study.

APPENDIX I: FATHER PERCEPTION OF IMPACTS DUE TO THE COVID-19 PANDEMIC

Topic	Percent Impact on Father/household		
	Did not affect me	Affected me a little	Affected me a lot
You were admitted to the hospital.	82.1	8.3	9.6
You had a serious accident or illness	70.7	15.4	13.8
Your partner had a serious accident or illness.	70.9	18.6	10.5
A friend/family member had a serious accident/illness.	61.6	26.1	12.3
Your partner died.	74.0	14.1	11.9
A friend or relative died.	59.5	25.6	14.9
You experienced a significant drop in income.	46.2	32.1	21.7
You had trouble paying your bills	46.7	32.1	21.1
You became homeless.	70.2	17.9	11.9
You moved or changed residence	66.6	22.1	11.3
You started living with your partner	75.1	15.5	9.4
A friend/family member moved in	69.2	21.9	8.9
A friend/family member moved out	69.5	23.5	7.0
You got married	72.7	15.1	12.2
You were separated/divorced.	72.3	17.4	10.3
You started a new job	60.5	24.1	15.4
You had serious problems with childcare	54.1	29.1	16.8

APPENDIX J: COVID-19 PANDEMIC IMPACT ON FAMILY MEALS

AND ASSOCIATED ROUTINES

Topic	Percent Impact on Household		
	No change	Some change	A lot of change
1. How often we eat meals together in the household	44.7	44.5	10.8
2. How often I eat breakfast with my 6 -11-year-old child	54.3	36.9	8.8
3. How often I eat lunch with my 6 -11-year-old child	46.7	41.3	12.0
4. How often I eat dinner with my 6 -11-year-old child	56.0	32.4	11.5
5. How often I eat snacks with my 6 -11-year-old child	51.7	38.2	10.1
6. My involvement in feeding my 6 -11-year-old child	53.7	36.0	10.3
7. My participation in preparing meals	47.2	41.7	11.1
8. My participation in shopping for meals	45.9	38.3	15.7
9. My involvement in monitoring what my 6 -11-year-old child eats for meals and snacks.	49.6	40.8	9.6

APPENDIX K: FATHER PERCEPTIONS OF ECONOMIC SUFFICIENCY

Measure	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree
My family has enough money to afford the kind of:					
1. Home we would like to have	16.4	13.4	12.7	15.1	42.4
2. Clothing we should have	6.5	12.8	16.5	16.8	47.4
3. Furniture or household equipment we should have	5.8	10.3	19	23.1	41.9
4. Car we should have	11	11	17.2	19.2	41.6
5. Food we should have	5.2	10.9	17.1	17.1	49.6
6. Medical care we should have	9.2	14.9	14.4	15.6	45.9
7. Leisure and recreational activities we want to participate in	7.5	16.7	19.4	21.6	34.8
8. Our income never seems to catch up with our expenses	24.1	13.7	13.4	15.7	33.1

APPENDIX L: FATHER PERCEPTION OF SOCIAL SUPPORT

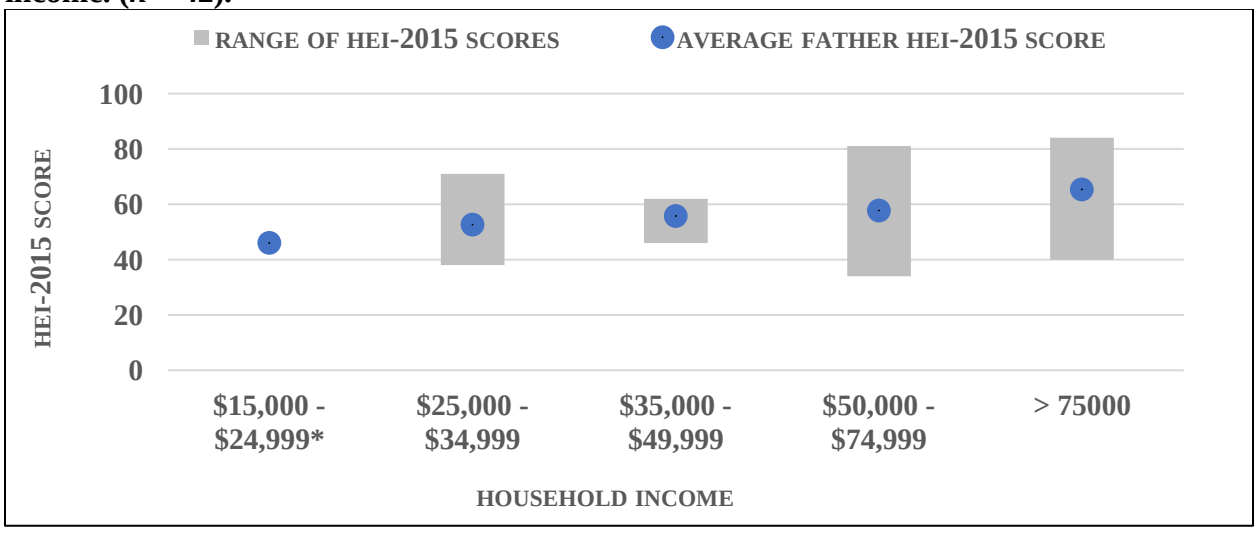
Measure	Percent Father Agreement			
	Strongly disagree	**Disagree**	**Agree**	**Strongly agree**
1. There are people I can depend on to help me if I really need it.	1.2	7.6	47.9	43.2
2. There are people who enjoy the same social activities I do	0.2	5.9	54.2	39.7
3. I have close relationships that provide me with a sense of emotional security and well-being.	1.0	7.9	47.2	44.0
4. There is someone I could talk to about important decisions in my life.	0.5	8.6	43.2	47.7
5. I have relationships where my competence and skill are recognized.	1.2	6.9	46.6	45.3
6. There is trustworthy person I could turn to for advice if I were having problems.	0.0	6.7	45.7	47.7
7. I feel part of a groups of people who share my attitudes and beliefs.	0.5	9.9	45.7	44.0
8. I feel a strong emotional bond with at least one other person.	1.0	10.1	42.3	46.7
9. There are people who admire my talents and abilities.	1.0	6.6	51.8	40.5
10. There are people I can count on in an emergency.	0.5	4.2	46.9	48.4

APPENDIX M: MEAN FATHER HEI-2015 SCORE BY

HOUSEHOLD INCOME (*N* = 42)

Household Income	N	Mean HEI -2015 score	SD	Minimum HEI-2015 score	Maximum HEI-2015 score
Less than $15,000					
$15,000 to $24,999		46.00	0	46.00	46.00
$25,000 to $34,999		52.50	15.33	38.00	71.00
$35,000 to $49,999		55.67	5.22	46.00	62.00
$50,000 - $74,999	6	57.63	10.99	34.00	81.00
more than $75,000	2	65.25	12.76	40.00	84.00

Average father HEI-2015 scores and the distribution of HEI-2015 scores by household income. (*n* = 42).

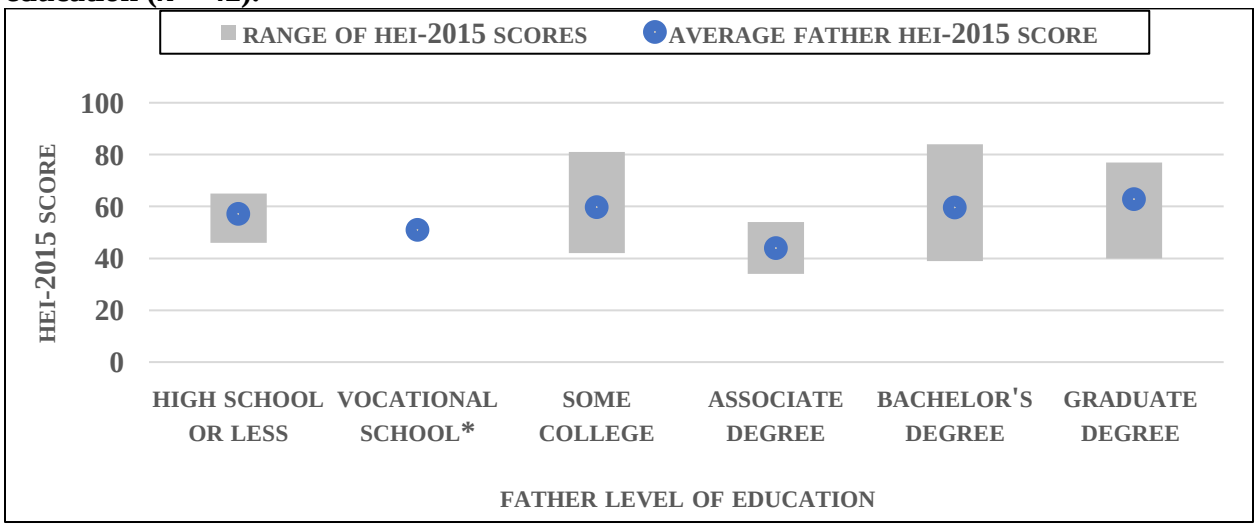


*Only one father in income range $15,000-24,999.

APPENDIX N: MEAN FATHER HEI-2015 SCORE BY FATHER EDUCATION

Education	N	Mean HEI -2015 score	Standard Deviation	Minimum HEI-2015 score	Maximum HEI-2015 score
High school or less	5	57.20	7.23	46.00	65.00
Vocational school	1	51.00	NA	51.00	51.00
Some college	15	59.80	8.48	42.00	81.00
Associate degree	4	44.00	9.52	34.00	54.00
Bachelor's degree	5	59.60	16.99	39.00	84.00
Graduate degree	12	62.83	12.26	40.00	77.00

Average father HEI-2015 scores and the distribution of HEI-2015 scores by level of father education (*n* = 42).



*Only one father in vocational school education category.