AN EXAMINATION OF HOUSEHOLD ENVIRONMENTAL INFLUENCES ON HEALTHY EATING BEHAVIORS AMONG AFRICAN AMERICAN PRIMARY CAREGIVERS AND CHILDREN

A Dissertation

by

TYA MICHELLE ARTHUR

Submitted to the Office of Graduate Studies of
Texas A&M University
in partial fulfillment of the requirements for the degree of

DOCTOR OF PHILOSOPHY

December 2010

Major Subject: Health Education

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Approved by:

Chair of Committee,	E. Lisako J. McKyer
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	James Lindner
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ABSTRACT

An Examination of Household Environmental Influences on Healthy Eating Behaviors among African American Primary Caregivers and Children. (December 2010)

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M.P.H., Texas A&M Health Science Center

Chair of Advisory Committee: Dr. E. Lisako J. McKyer

The burden of obesity and related health conditions is particularly high among African Americans and low-income families. A large body of evidence demonstrates the benefit of following a diet recommended by federal dietary guidelines in reducing obesity risk and promoting overall health. The environment plays an important role in the development of childhood obesity by influencing mechanisms related to dietary behavior patterns. This study used secondary data from a Texas state and national survey of Women, Infants, and Children (WIC) participants prior to the implementation of food package changes in 2009. The purpose of the study was to describe diet quality, examine relationships between diet quality and sociodemographic factors, and investigate household environmental influences on fruit and vegetable consumption among African American children.

A healthy food indicator with four components indicative of a healthy diet, namely fruits, vegetables, whole grains, and low-fat milk, was used to measure diet quality. African American women and children in this study's sample did not meet the

standards for a healthy diet. Personal and family characteristics, including age, caregiver education, urbanization, and region of residence, were associated with diet quality in African American women and children.

The majority of African American children in this sample did not meet current recommendations for daily fruit and vegetable consumption. Six household environmental factors were associated with fruit and vegetable consumption by African American children, including physical factors (primary caregiver purchase and preparation of fruits and vegetables) and sociocultural factors (primary caregiver fruit and vegetable consumption, perception of child liking fruits and vegetables, fruit and vegetable selection self-efficacy, and self-efficacy for healthful child feeding). The strongest predictor of fruit and vegetable consumption by African American children was the fruit and vegetable consumption by primary caregivers.

Health education strategies aimed at improving diets of African Americans need to address a variety of sociodemographic and household factors influencing dietary behavior patterns. Strategies to promote the reduction of childhood obesity through increases in fruit and vegetable consumption must account for the consumption of fruits and vegetables among primary caregivers.

DEDICATION

This dissertation is dedicated to

My late father

My mother

ACKNOWLEDGEMENTS

"Knowing is not enough; we must apply
Willing is not enough; we must do."
~ Goethe

I am humbled to have the opportunity to complete my doctoral studies at Texas A&M University. I am foremost thankful to God.

I would like to thank my late father, Warren, for his sacrifice and dedication to his family. I would also like to thank my mother, Olita, for her unwavering support. I am blessed to have you as a parent. Trey, Angelé, and Crystal, thank you for laying the foundation for me as my older siblings. I could not have asked for a better brother and sisters. Parents, siblings, Nanny, and CJ, I love you all!

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CHAPTER I

INTRODUCTION: THE IMPORTANCE OF RESEARCH

Background

Obesity among adults and children has increasingly become a major health concern in the United States. Currently, about two-thirds of the overall population is overweight or obese.[1] Obesity has more than tripled among children and adolescents and more than doubled among adults in the past 30 years.[1-3] The dramatic rise of obesity among all age categories has led to the ascension of the condition to the second leading cause of preventable death in the United States.[4]

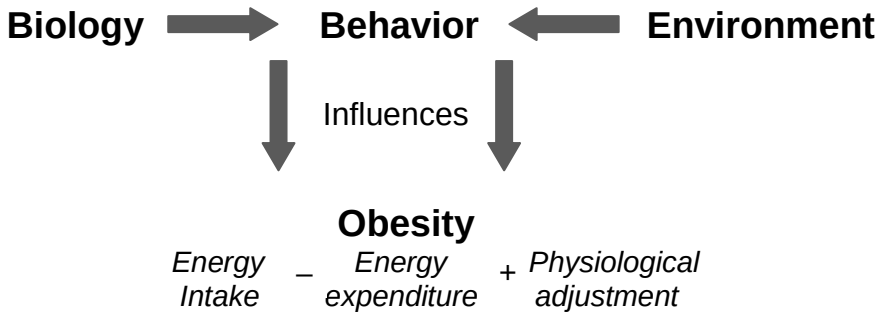
The burden of obesity is greatest among the African American population. Currently, about four out of five African American women over the age of 20 are overweight or obese.[1] The prevalence of overweight or obesity among African American children 2 to 5 years old is 26%.[2] The obesity prevalence within the African American population, especially among African American women and preschool-aged children, underscores the importance of conducting obesity research targeting these groups.

Obesity results from an imbalance between energy consumed and the daily energy consumed and the daily energy needs of the body.[5-7] Egger and Swinburn[8]

This dissertation follows the style of the *American Journal of Health Promotion*.

developed a model to conceptualize the influences of obesity. Figure 1.1 illustrates the model in adapted form. Biology, behavior, and the environment are included in the model as the three primary influences on the balance between energy intake and energy expenditure, both mediating determinants in excess weight. There is agreement among experts suggesting the environment, rather than biology, has the most influence on obesity.[9,10] Biology is a contributing factor of individual differences in height, weight, and metabolism, but the environment is the primary cause for the dramatic increase in obesity in the United States in the past 30 years. The growing obesogenic environment promotes the overconsumption of energy and discourages energy expenditure.[11]

Figure 1.1
Ecological Model for Influences of Obesity



Model adapted from Egger and Swinburn[8].

Despite the role of the environment in the development of obesity, relatively little is known regarding environmental correlates of, and influences on, health behavior (e.g.,

diet).[12] This study provides an examination of a subset of obesity-related factors in an effort to gain a greater understanding of the role of the environment in dietary behaviors by African Americans, particularly among children.

Problem Statement

Eating behaviors of children do not currently meet the recommendations outlined in the *Dietary Guidelines for Americans* (*Dietary Guidelines*) developed by the U.S. Department of Health and Human Services (HHS) and U.S. Department of Agriculture (USDA).[13] Improvement to the diets of children is needed. Based on a national study, children need to consume more whole fruit, whole grains, dark green and orange vegetables, and legumes and reduce consumption of sodium and discretionary calories in the form of fats and sugars.[14] The current trend in diets among children is of concern because poor eating behaviors in childhood may be detrimental to growth and development and contribute to less than optimal dietary patterns in adulthood.[15]

The food environment established by the family plays an important role in what children learn about food and eating during the preschool years.[16] The public health literature suggests the majority of eating behaviors are defined within the family context.[7] When children start to consume adult food, learning about what, when, how much, and rituals regarding food and appropriate eating behavior begins.[17,18] Parents and caregivers are integral to the development of proper eating behaviors in children as they are considered a source of authority and a role model for children.[19] Those that fulfill the primary caregiver role in the lives of children shape choices important to the formation of life-long healthy behaviors based on what is promoted, rewarded, and

reinforced.[20] Since childhood obesity is generally not isolated in the overall familial context, characteristics of the family food environment can predict children's obesity risk.[21]

The cultural, racial, and ethnic diversity and size of the United States, and Texas on the state level, makes the development of research targeting specific sub-populations necessary. Ethnic/racial disparities in health affecting minority populations are an important piece of the overall state of health in the United States. Still, disparities in obesity and diet- and obesity-related conditions persist among the African American population and the need for additional research continues. In particular, there is still a lack of clarity in understanding the influence of family and household environmental factors on eating behaviors among low-income African American primary caregivers and children.

Purpose of the Study

Reducing overweight and obesity in children is a national public health priority.[22] To return to a childhood obesity rate of 5% by 2030, as outlined by the White House Task Force on Obesity,[20] effective prevention strategies to reduce childhood obesity will require a focus on environments and policies targeting families, child care centers, and communities to promote a healthy diet and physical activity.[23] Behaviors established in childhood and adolescence are difficult to modify as they continue into adulthood.[24] Thus, intervening in early childhood to prevent the development of obesity-related behaviors is critical. If healthy eating behaviors are learned in childhood and maintained, then chronic disease risk in early years and later life will be minimized.[25]

Given the current data on obesity throughout the life-course and the importance of early childhood as a critical period in the development of eating behaviors, the need for additional research focused on identifying the factors contributing to the onset of obesity in childhood persists. Instead of a single overall solution to the obesity epidemic, many small changes are needed.[26] Although no single action will change the current trajectory of childhood obesity in the United States, there is no question about the improvement of eating behaviors as one critical strategy in the effort to solve the problem of childhood obesity in one generation.[20]

Interventions targeting intrapersonal, sociocultural, policy, and physical-environmental factors are viewed as more effective than individually-based approaches by themselves.[12] However, before multilevel, ecologically-based approaches to obesity interventions for the low-income African American population can proceed, it is necessary to advance the current understanding of specific environmental factors contributing to obesity-related behaviors. The paucity of literature on environmental influences of health behavior involving research conducted on majority African American participants underscores this need.

The familial aggregation of behaviors and characteristics based on frequency and pattern makes the study of environmental factors contributing to similarities within families an important first step in the process of understanding components essential to effective obesity intervention strategies. The overall purpose of this study was to contribute to the understanding of environmental influences on eating behaviors of low-income African American children and primary caregivers by investigating diet quality

and sociodemographic factors— age, sex, education, urbanization, region of residence— and fruit and vegetable consumption and household environmental factors— primary caregiver education, work status, fruit and vegetable consumption, perception of child preference for fruits and vegetables, fruit and vegetable selection self-efficacy, self-efficacy for feeding child healthful food purchase of fruits and vegetables, and preparation of fruits and vegetables.

Nature of the Study

The development of effective prevention and intervention strategies requires a sound understanding of key factors driving the obesity epidemic in children. The ecological perspective was used to study the impact of household environmental factors on children's eating behaviors. To explore the current literature on factors within the household environment associated with fruit and vegetable consumption, obtain information on diet quality, and household environmental factors influencing fruit and vegetable consumption by low income, African American children, a systematic review and secondary data analyses were conducted.

Research Questions

Several research questions were developed to explore maternal and child nutrition within the African American population:

Question 1 (Q1): What is known by public health research about household environmental factors associated with fruit and vegetable consumption among African American children?

Question 2 (Q2): What is known by public health research about the direction of the association between household environmental factors and fruit and vegetable consumption by African American children?

Question 3 (Q3): What is the diet quality (as measured by the healthy food indicator) of low-income African American women and children based on fruit, vegetable, whole grain, and milk consumption?

Question 4 (Q4): What sociodemographic factors are related to the diet quality of low-income African American women and children in the United States?

Question 5 (Q5): What is the nature of the relationships between the consumption of fruits and vegetables by African American children and female caregiver's personal and eating-behavior factors (e.g. education, work status, perception of child liking fruits and vegetables, consumption of fruits and vegetables, fruit and vegetable selection self-efficacy, self-efficacy for feeding child healthful food, purchase of fruits and vegetables, and preparation of fruits and vegetables)?

Research Design

To address the proposed research questions, this dissertation study included: 1) a systematic review of existing literature and 2) secondary data analyses of the National Food and Nutrition Questionnaire (NATFAN) and Texas WIC Food and Nutrition Questionnaire (TEXFAN) data. The systematic review followed approaches outlined by Petticrew and Roberts,[27] Garrad,[28] and Jackson[29] for reviews in the social sciences. Data from the baseline administration of the NATFAN and TEXFAN questionnaires were used for the secondary data analyses. Data analyses were framed by theory to assist in

the selection of relevant variables and to explain the outcomes described. This research design allowed for the exploration of current literature on household environmental factors related to fruit and vegetable consumption and added to current understanding of dietary behaviors and environmental factors.

Significance of the Study

Despite recent increases in the prevalence of obesity and development of chronic conditions among children, evidence for successful treatments for obesity is limited.[30] A large body of evidence has highlighted the role of nutrition and dietary consumption in the prevention and management of chronic diseases.[31] Intervention strategies to promote healthy eating behavior are more effective when based on prevailing evidence regarding dietary practices and influences on those practices.[32] This study contributes to the understanding of the influence of environmental factors on dietary behaviors, thus can benefit the development of effective intervention strategies.

Health educators, nutritionists, and public health practitioners, and researchers may have interest in the results of this study. In addition, stakeholders of the national and Texas state-level WIC program—namely policy makers, administrators, curriculum developers, instructors, and participants— will have interest in the results. The information obtained from this study provides insight into the types of dietary changes needed to improve healthy eating behaviors and the influence of household environmental factors on fruit and vegetable consumption by children. This study will assist in moving obesity research forward by describing factors and relationships between factors to understand nutrition behavior. The greater understanding of diet

quality and environmental correlates of fruit and vegetable consumption produced by this study should lead to more effective and efficacious intervention strategies leading to the reduction of current trends in childhood obesity and wide-reaching, long-lasting positive outcomes for low-income African Americans.

Chapter Summary

This chapter included an introduction to issues related to obesity and the purpose and significance of the study, research questions, and study design. The next three chapters are manuscripts developed to report the findings of this study. Chapter II is a systematic review of household environmental factors associated with fruit and vegetable consumption by African American children. Chapter III reports the diet quality of low-income African American women and children and the relationship between diet quality and select sociodemographic factors. The third manuscript, Chapter IV, presents and analyzes a model describing the relationship between fruit and vegetable consumption by children and household environmental factors. Finally, Chapter V provides recommendations and conclusions based on the study findings.

CHAPTER II

INFLUENCES OF HOUSEHOLD ENVIRONMENT ON FRUIT AND VEGETABLE CONSUMPTION BY AFRICAN AMERICAN CHILDREN: A SYSTEMATIC REVIEW

Overview

Objective: Explore the current published literature on household environmental factors associated with fruit and vegetable consumption by African American children and describe the direction of associations between consumption and environmental factors. Data Sources: Electronic database searches of MEDLINE, CINAHL, Agricola, ERIC, and Education Full Text were conducted to find relevant studies. Study Selection: Peer-reviewed articles published from 1990-2010 were included if the majority of participants were African American, the primary focus was children 3-12 years old, assessed at least one aspect of the household environment, and fruit and vegetable consumption was a variable of interest. Only non-intervention studies were considered in the review. Data Extraction: The matrix method was used to organize the extraction of data on methodological details and findings related to the objectives of the review. Data Synthesis: The description of included studies and review findings are summarized in Tables 2.1-2.3. Results: Ten studies met the final inclusion criteria. Relationships between home availability, participation in food preparation, parental modeling, allowance/pocket money, and kitchen restrictions and children's fruit and vegetable consumption were found in the literature. Conclusions: Further investigation of

environmental factors related to fruit and vegetable consumption by African American children is needed.

Introduction

The consumption of fruits and vegetables is one of the most important dietary components in the promotion of health. Eating a diet rich in fruits and vegetables is protective against many common chronic diseases, including cardiovascular disease, stroke, diabetes, and some cancers.[33] Although the majority of research investigating the association between chronic disease and fruit and vegetable consumption has focused on adults, there is evidence of a protective effect of fruits and vegetables on many childhood illnesses.[34] Fruits and vegetables may also play an important role in weight management and obesity prevention.[35] In children, higher fruit and vegetable consumption is inversely associated with body mass index.[36,37] Since obesity in childhood is a precursor to obesity in adulthood and predisposes to increased risk of all-cause adult mortality, promoting leptogenic behaviors in children, such as fruit and vegetable consumption, is important to health through the lifecourse.[38]

Despite the health benefits, children continue to fail to consume the daily recommended amount of fruits and vegetables.[39,40] Although adults are able to make autonomous food choice decisions, most children are restricted to making decisions about whether or not to eat the foods provided and not what type or quantity of food served.[41] Thus, eating behavior among children is likely strongly influenced by factors within the environment.[42]

Ecological models incorporate individual-level factors while accounting for environmental influences on behavior.[43] The ecological perspective described by Swinburn et al[44] divides the environment into macro-level entities (e.g., media, government, health systems) and units characterized by small, distinct settings malleable to the influence of individuals (e.g., schools, neighborhoods, homes).[44] The household is a micro-level environment composed of all related and unrelated individuals, resources, and circumstances within the same housing unit impacting the health and development of children. The shared household environment is an important component where children learn and practice eating behaviors.[45]

Rasmussen et al[46] conducted a review of the literature on the determinants of fruit and vegetable consumption by children and adolescents aged 6-18 years. The review sought to provide an international overview of personal and environmental factors influencing consumption. The greatest amount of evidence supported the association between personal factors, including age, gender, preferences, and environmental factors, including socioeconomic status, parental intake, and home availability and accessibility of fruits and vegetables.[46] A systematic review focused on the influence of environmental factors on dietary behaviors was conducted by van der Horst and colleagues.[42] The review synthesized the environmental correlates of energy, fat, fruit and vegetable, snack and fast food, and soft drink intakes for children (4-12 years) and adolescents (13-18 years) separately. Results for fruit and vegetable consumption among children indicated consistent associations with parental consumption and home availability and accessibility.[42]

Pearson et al[47] conducted the most recent review of associations between the family environment and fruit and vegetable consumption by children (6-11 years) and adolescents (12-18 years). Observational studies measuring at least one family correlate and fruit and vegetable consumption were included in the review. Positive associations were reported for children's fruit and fruit, juice, and vegetable consumption with parental modeling and parental consumption. Home availability, family rules, and parental encouragement were consistently associated with children's fruit and vegetable consumption.[47] Although Pearson and colleagues[47] examined literature on family correlates of fruit and vegetable consumption, similar to the work of Rasmussen et al[46] and van der Horst et al,[42] the systematic review included studies published in and outside of the United States. The population of interest in the Pearson et al[47] review only included school-aged children and racial or ethnic differences were not considered.

The present review will adapt the processes of previous reviews to focus on a specified population, African American children 3-12 years. At approximately 3 years of age, children no longer have deprivation-driven eating patterns and are influenced by environmental cues regarding food consumption.[48] Eating patterns established in childhood have the potential to track into adulthood,[49] thus preventing the establishment of poor dietary behaviors at an early age is essential. Cultural and ethnic influences leading to variations in obesity-related attitudes, beliefs, and behaviors warrants attention to the African American population.[50] The influence of historical effects on dietary patterns and food resource inadequacies are examples of cultural and socioeconomic factors potentially impacting fruit and vegetable consumption among

African Americans.[51] Additionally, disparities in the prevalence of obesity and other risk factors for heart disease and stroke among African Americans gives credence to the importance of continued research on health-related determinants.[52,53]

To our knowledge, this is the first review of household environmental correlates of fruit and vegetable consumption by African American children. Understanding determinants of eating behaviors is critical to establishing strategies to prevent obesity and nutrition-related diseases. The ANGELO framework, an ecological conceptual model outlined by Swinburn et al,[44] was chosen as a means to articulate the distinct environmental types within the micro-level household environment. The environmental types within the framework include the physical, sociocultural, economic and political environments.[44]

This review focused on addressing the following research questions:

(1) What is known about the factors of the household environment associated with fruit and vegetable consumption by African American children?

(2) What is the direction of the association between household environmental factors and fruit and vegetable consumption by African American children?

Methods

Data Sources and Search Strategy

A literature search was conducted in March 2010 to locate studies examining household environmental level influences on fruit and vegetable consumption among African American children. Studies eligible for inclusion in the review were identified from electronic database searches of MEDLINE, CINAHL, Agricola, ERIC, and

Education Full Text. The search was limited to peer-reviewed articles in English and published from 1990-2010, an effort to exclude studies published prior to changes in the *Dietary Guidelines for Americans*[54] to explicitly recommend eating fruits and vegetables. Key search terms for dietary behaviors included feeding behavior, diet behavior, food behavior, nutrition behavior, diet, food habit, food preference, fruits, and vegetables. Dietary behavior terms were combined with the search terms obesity or diabetes and African American or black to further isolate relevant studies. Exploded MeSH headings were used when applicable and key terms were modified based on database-specific criteria. A research librarian assisted in the development of the search strategy for this review.

Inclusion and Exclusion Criteria

The first author selected potentially relevant articles by screening the titles and abstracts for preliminary inclusion criteria. Studies selected in the preliminary assessment of relevance were required to: (1) be published in English from 1990-2010, (2) be located in the United States, (3) include African American children and/or parents, (4) have fruits and vegetables as a variable of interest, and (5) assess at least one aspect of the household environment. The screening process was independently performed by a research librarian on ten percent of the articles to ensure objectivity of the screening process.

A secondary assessment was conducted on the entire full text of studies meeting required criteria in the preliminary round. For inclusion, studies in the second assessment were eligible if: (1) a non-intervention study design was used, (2) the

majority of the participants were African American, and (3) the majority of participants, or the primary focus of the research, were children 3-12 years. Purling (searching reference lists and publications citing included studies) was conducted to supplement the literature search using the SCOPUS database.

Data Extraction and Data Synthesis

Quality assessments were performed on qualitative and quantitative studies separately using the CASP and STROBE Statement critical appraisal tools, respectively.[55] Data were extracted using standardized summary tables for each study design developed for this review based on the Garrard[28] matrix method. Extracted data included methodological details and findings related to the objectives of the review. Study design, objective, theoretical basis, characteristics of the participants (sample size, age, gender, proportion African American), location, assessment methodology, statistical analysis (if applicable), dietary variables, household environmental factors and relevant findings were included in the matrix. Themes involving fruit and vegetable consumption and household environmental factors were identified from qualitative studies. Associations between household environmental factors and fruit and vegetable consumption were extracted from quantitative studies to address the second research question. Significant associations were designated when the *p*-value provided in the study was <0.05. The ANGELO framework was used to synthesize the data by type of environmental factor (physical, sociocultural, economic, and political) and summarize the data in narrative form.[44]

Results

Description of Included Studies

The literature search located 245 unique, potentially relevant articles (Figure 2.1). The preliminary screening process yielded 57 studies for full text retrieval and assessment. The secondary inclusion screening excluded 49 studies from the review. After two additional articles were identified through purling, 10 studies met the final inclusion criteria. Four studies used qualitative methodology[56-59] and 6 studies were quantitative[36,60-64] using a cross-sectional study design (Table 2.1). The majority of studies (n = 7) included samples recruited in the South (e.g., Texas, Tennessee, Alabama, Georgia, Mississippi).[36,56-58,60,62,63] One-half of the studies contained 100% African American samples.[36,58-60,63] Seven studies analyzed data from parents and children.[36,56,57,60-63]

Sample sizes of the qualitative studies ranged from 21 to 235 children and three out of four studies used focus groups to collect data. Quantitative study sample sizes ranged from 114 to 775 children. Diet-related measures included 24-hour recall interviews[36,60,62,63] and food frequency questionnaires.[61,64] Three of four qualitative studies used focus groups to collect data[56-58] and the majority (n = 4) of quantitative studies used self-reported data for diet-related consumption.[36,60,63,64] Fruit and vegetable consumption was conceptualized and analyzed as a composite measure in 6 studies [56,57,60-63] and separately in the remaining 4 studies.[36,58,59,64]

Figure 2.1
Flowchart of Study Selection Process

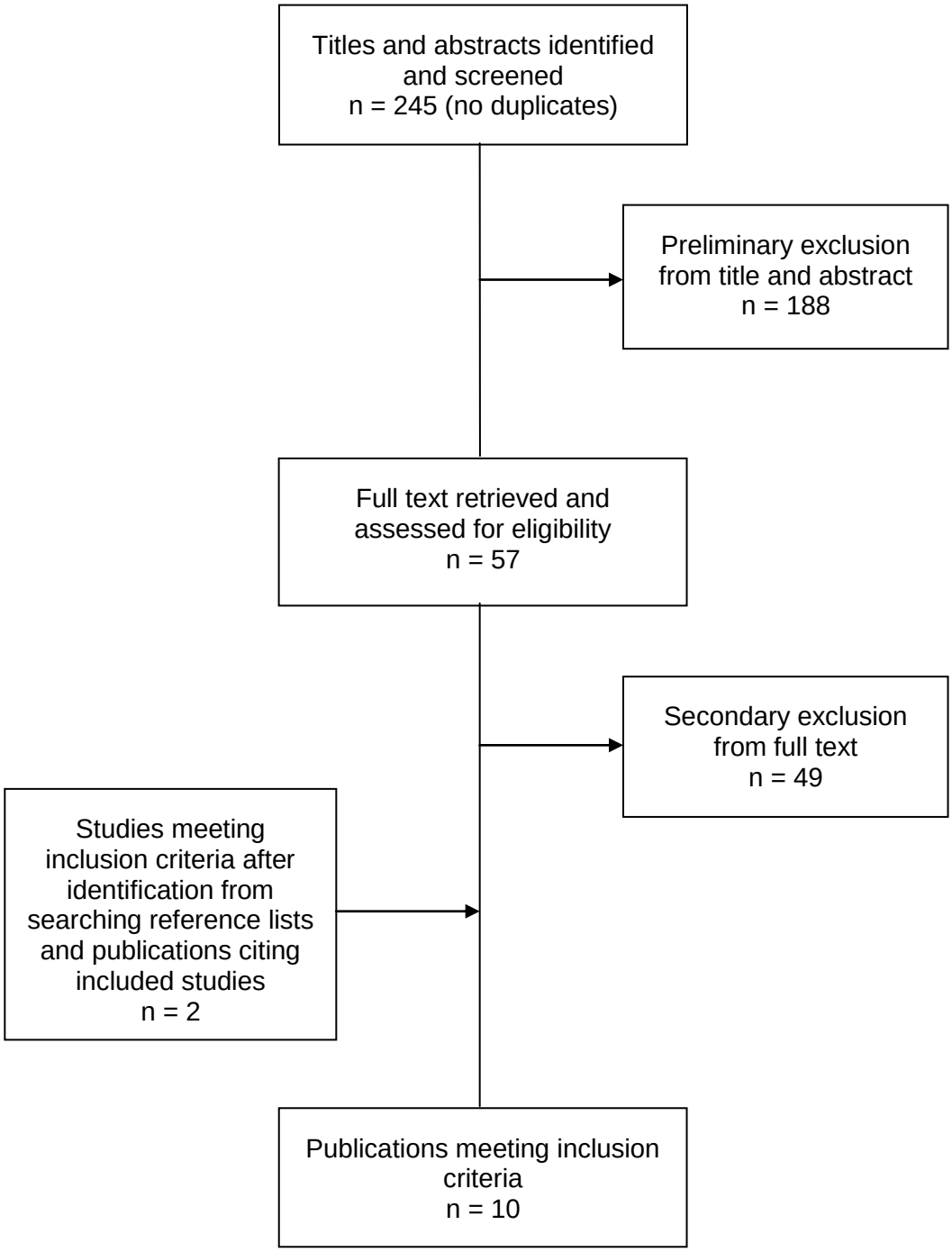


Table 2.1
Characteristics of Studies Included in the Review

Study	Study Objective	Sample	Diet-related Data Collection	Location	Dietary Outcomes of Interest
Quantitative					
Cullen et al, 2004[36]	Identify anthropometric, parental, and psychosocial characteristics and meal practices associated with dietary intake	C: n = 114 (F); 7-10 y; 100% AA P: n = 114	24-hr recall; self-report	Houston, TX; Memphis, TN; Minneapolis, MN	Fruit intake; vegetable intake; juice intake
Cullen et al, 2004[60]	Examine psychometric properties of diet-related psychosocial measures	C: n = 114 (F); 7-10 y; 100% AA P: n = 114	24-hr recall; self-report	Houston, TX; Memphis, TN; Minneapolis, MN	Composite fruit, vegetable, juice intake
Mushi-Brunt et al, 2007[61]	Examine relationship between food spending behaviors/perceptions and fruit and vegetable intake	C: n = 555 (M,F); 6-12 y; 71% AA P: n = 555	FFQ; parent report	St. Louis, MO	Composite fruit and vegetable intake
O'Conner et al, 2010[62]	Assess the association of parenting practices and fruit and vegetable intake	C: n = 775 (M,F); 3-5 y; 43.8% AA P: n = 775	24-hr recall; parent report	Houston, TX; Northern Alabama	Composite fruit and vegetable intake
Sherrill-Mittleman et al, 2009[63]	Evaluate measurement characteristic of diet-related psychosocial scales	C: n = 303 (F) 8-10 y; 100% AA P: n = 303	24-hr recall; self-report	Memphis, TN	Composite fruit, vegetable, juice intake

Table 2.1 continued

Study	Study Objective	Sample	Diet-related Data Collection	Location	Dietary Outcomes of Interest
Wang et al, 2007[64] 2007	Assess overweight and related risk factors	C: n = 498 (M,F); 5th-7th grade; 98.8% AA	FFQ; self-report	Chicago, IL	Fruit intake; vegetable intake
Qualitative					
Baranowski, et al, 1993[56]	Explore reciprocal determinism and obtain data on fruit and vegetable practices and related factors	C: n = 235 (M,F); 4th-5th grade; >50% AA P: n = 15	Focus group	Richmond County, GA	Composite fruit and vegetable intake
Cullen et al, 1998[57]	Identify fruit and vegetable intake factors and evaluate a potential intervention	C: n = 99 (M); 10-14 y; 88% AA P: n = 39	Focus group	Houston, TX	Fruit intake; vegetable intake; composite fruit and vegetable intake
Molaison et al, 2005[58]	Identify person, behavioral, and environment factors associated with fruit and vegetable intake	C: n = 21 (M); n = 21 (F); 10-13 y; 100% AA	Focus group	Mississippi Delta	Fruit intake; vegetable intake

Table 2.1 continued

Study	Study Objective	Sample	Diet-related Data Collection	Location	Dietary Outcomes of Interest
Reimer et al, 2004[59]	Examine relationship between child-feeding strategies and stage of change	n = 70 (F); mothers of children <12 y 100% AA	Interview	Minnesota	Fruit intake; Vegetable intake

C = child participants; P = parent/caregiver participants; F = girls only; M,F = boys and girls combined; AA = African American; FFQ = food frequency questionnaire

Qualitative Studies

The findings from the qualitative studies are summarized in Table 2.2. Child participation in food preparation,[56-58] parent or grandparent modeling, [56,57,59] and parental preparation of properly cooked vegetables with tasteful additives[57-59] were consistently identified as sociocultural factors related to fruit and vegetable consumption by African American children. Sociocultural factors including parent and family support,[57,58] not purchasing or replacing sweets in favor of fruits and vegetables,[57,59] and positive statements by parents to encourage fruit and vegetable consumption[57,59] were also described in multiple qualitative studies. Parental affinity toward fruits and vegetables,[56] training children to eat fruits and vegetables in early childhood,[57] incorporating vegetables into prepared foods,[59] and child participation in food shopping[56] were not uniformly identified in the qualitative studies, but are worth noting in this review as factors related to fruit and vegetable consumption among African American children.

Fruit and vegetable availability, or lack thereof, within the home was identified as a physical environmental factor influencing fruit and vegetable consumption.[56-58] Monetary child allowance was the only factor identified in the qualitative studies as an economic determinant.[56] Parent-enforced limitations on kitchen-related activities, such as restrictions on the use of kitchen equipment[57] and admittance into the kitchen,[56] were described as influences on fruit and vegetable consumption by African American children within the political household environment.

Table 2.2
Summary of Qualitative Study Findings by Household Environment Type

Study	Physical	Sociocultural	Economic	Political
Baranowski et al, 1993[56]	F&V[a] availability	Parent liking F&V; child participation in food shopping; child participation in food preparation; grandparent modeling	Child allowance	Child not allowed in kitchen
Cullen et al, 1998[57]	F&V availability	Parental support; not purchasing sweets; training children early to eat F&V; child participation in food preparation; parental preparation of tasteful vegetables; parental preparation of properly cooked vegetables; parental modeling; parents' positive statements about F&V		Restrictions on kitchen equipment; restrictions on television viewing
Molaison et al, 2005[58]	Lack of availability at home	Preparation of tasteful vegetables; child participation in preparation of meals and snacks containing F&V; positive family support; mothers and grandmothers are primary decision-makers at home		

Table 2.2 continued

Study	Physical	Sociocultural	Economic	Political
Reimer et al., 2004[59]	Buying and keeping F&V on hand for snacks	Adding vegetables to dishes; hiding vegetables in dishes; add something to enhance F&V; include F&V in lunches; replace junk food with fruits and vegetables; encourage children to eat F&V; parent modeling while grocery shopping and preparing meals at home; role-modeling F&V consumption		

[a]F&V = fruit and vegetable

Cross-sectional Studies

Table 2.3 summarizes the household environmental correlates of fruit and vegetable consumption as identified in the quantitative studies included in this review. The findings from six cross-sectional studies were synthesized. Of the four environmental types, only factors within the physical, sociocultural, and economic environments were examined in the studies and classified in this review.

Physical Environment

Four studies measured physical factors at the household environmental level.[36,60,62,63] Home availability of fruits, juice, and vegetables and low-fat food were examined three times in relation to fruit and vegetable consumption.[36,60,63] Home availability of high fat foods was studied two times[36,60] and home availability of fruits and vegetables was studied once[62] in the included literature. Barriers to home fruit, juice, and vegetable consumption and low-fat food consumption were examined in one study with one sample[60] as well as home accessibility of fruit, juice, and vegetables.[36]

At the household physical level, home accessibility of fruit, juice, and vegetables was inversely associated with 100% fruit juice consumption in one study. In the same study, home accessibility was unrelated to child fruit or vegetable consumption.[36] The availability of fruits and vegetables was positively associated with higher consumption of fruit[62] and the availability of fruit, juice, and vegetables was positively associated with fruit and vegetable consumption as a composite measure.[63]

Table 2.3
Summary of Quantitative Home/household Environmental Correlates of Fruit and Vegetable Intake among African American Children (3 to 12 years)

Correlate	Related to fruit and vegetable intake	Association (+[a] or -[b])	Unrelated to fruit and vegetable intake	Summary				
				F[c]	V[d]	J[e]	F&V[f]	FVJ[g]
Physical								
Home accessibility of FJV	Cullen et al, 2004[36] (J)	-	Cullen et al, 2004[36] (F,V)	+	-	-		
Home availability								
F&V	O'Connor et al, 2010[62]	+		+				
FJV	Sherrill-Mittleman et al, 2009[63]	+	Cullen et al, 2004[36], Cullen et al, 2004[60]	-	-	-	+	-
High-fat food			Cullen et al, 2004[36], Cullen et al, 2004[60]	-	+	+		-
Low-fat food			Cullen et al, 2004[36], Cullen et al, 2004[60], Sherrill-Mittleman et al, 2009[63]	+	-	+		-,+
Home FJV barriers			Cullen et al, 2004[60]					+
Home low-fat food barriers			Cullen et al, 2004[60]					+
Sociocultural								
Parent F&V intake	O'Connor et al, 2010[62]	+					+	

Table 2.3 continued

Correlate	Related to fruit and vegetable intake	Association (+[a] or -[b])	Unrelated to fruit and vegetable intake	Summary				
				F	V	J	F&V	FVJ
Food parenting practices								
Teachable moments			O'Connor et al, 2010[62]				+	
Practical methods	O'Connor et al, 2010[62]	+					+	
Firm discipline			O'Connor et al, 2010[62]				+	
Restriction of junk foods			O'Connor et al, 2010[62]				+	
Enhanced availability			O'Connor et al, 2010[62]				+	
Family supportive behavior			Sherrill-Mittleman et al, 2009[63]					-
Home preparation practices								
High-fat food preparation			Cullen et al, 2004[36], Cullen et al, 2004[60]	-	+	+		+
Low-fat food preparation			Cullen et al, 2004[36], Cullen et al, 2004[60]	+	+	+		+
Economic								
Household grocery spending	Mushi-Brunt et al, 2007[61]	+					+	
Child daily pocket money > US$2	Wang et al, 2007[64] (F)	+	Wang et al, 2007[64] (V)	+	+			
Cost as a barrier			Mushi-Brunt et al, 2007[61]	-	-			
F&V spending perceptions	Mushi-Brunt et al, 2007[61] (F)	-	Mushi-Brunt et al, 2007[61] (V)	-	-			

[a] '+' = positive association between environmental correlate and fruit and/or vegetable consumption;
[b] '-' = negative association between environmental correlate and fruit and/or vegetable consumption;
[c] F = fruit; [d]V = vegetable; [e]J = juice; [f]F&V = fruit and vegetable; [g]FJV = fruit, juice and vegetable;

Sociocultural Environment

Sociocultural factors were investigated in four studies.[36,60,62,63] Parent fruit and vegetable consumption and parenting practices (e.g., firm discipline, practical methods, teachable moments) were identified in one study.[62] Supportive behavior within the family was examined in one study[63] and the preparation of high-fat and low-fat foods at home was examined in two studies.[36,60]

Parent fruit and vegetable consumption, a sociocultural factor, was positively associated with fruit and vegetable consumption by children.[62] Among parenting practices, defined as parental actions to directly influence the behavior of children,[65] practical methods was the only practice significantly associated with fruit and vegetable consumption. Practical methods, such as incorporating additives to improve the taste of fruits and vegetables and affirmations for eating fruits and vegetables, was positively associated with children's fruit and vegetable consumption in one study.[62]

Economic Environment

Two studies measured economic factors at the level of the household environment.[61,64] One study examined household grocery spending, cost of fruits and vegetables as a barrier, and fruit and vegetable spending perceptions.[61] The amount of pocket money greater than $2 possessed by children daily was investigated in one study.[64]

At the economic level in the household environment, household grocery spending was positively associated with fruit and vegetable consumption.[61] The possession of pocket money greater than $2 by children was positively associated with

fruit consumption, but unrelated to vegetable consumption.[64] Another economic factor was fruit and vegetable spending perceptions. Fruit consumption was negatively associated with parental perception of increases in grocery spending with the purchase of fruits and vegetables instead of other snack foods.

Discussion

Main Findings of the Review

The present systematic review was conducted to explore the current published literature on household environmental factors associated with fruit and vegetable consumption by African American children. The review also sought to describe the direction of associations between consumption and environmental factors in cross-sectional, quantitative studies.

Comparable to the findings of previous systematic reviews on environmental factors,[42,47] the vast majority of household environmental factors identified in the qualitative and quantitative studies were of the sociocultural type. Although parents identified having children help in food preparation as a strategy to increase children's fruit and vegetable consumption,[57,59] this review also found that some children reported more participation in food preparation[58] than others.[57] Parental modeling of fruit and vegetable consumption was described as a positive or negative influence on consumption by children based on whether parents consume recommended amounts of healthful foods.[57,59] Unlike previous reviews, this review— based on the inclusion criteria— did not find studies quantitatively examining the association between parental modeling and child fruit and vegetable consumption.[42,47]

A physical environmental factor reported by parents and children with greater consistency in this review was the availability of fruits and vegetables within the home and its impact on the consumption of these two food groups.[36,56-58,60,66] When fruits and vegetables are readily available, maintaining higher consumption is less difficult for children. Availability, the presence of fruits and vegetables or fruit, juice, and vegetables in the home, was positively associated with greater fruit and combined fruit and vegetable consumption.[62,63] This finding did not deviate from systematic reviews by Rasmussen et al,[46] van der Horst et al,[42] and Pearson et al.[47] A separate relationship of availability with fruit and not vegetable consumption is a finding of previous research not found in this review.[67,68]

This review found the reported receipt of allowance from parents potentially provides children with the ability to directly influence the availability of fruits and vegetables in the household environment.[56] Pocket money provided by parents and maintained by children also emerged as an economic factor within the household environment. There was evidence of a positive association between children possessing pocket money greater than $2 daily and fruit consumption.[64] On the household political level, restrictions on the use of kitchen equipment and ability to enter the kitchen were suggested as hindrances on the ability of children to have access to and prepare fruits and vegetables, thus influencing consumption.[56,57]

Future Research

Since obesity in minority populations has yet to trend downward, research to identify influences on dietary behaviors is important to the creation of appropriate,

efficacious intervention approaches. Longitudinal, theory-based studies on household-level factors influencing fruit and vegetable consumption by African American children are needed to provide a more comprehensive exploration of key determinants. These determinants may be used to inform the development of interventions to improve dietary consumption and reduce obesity. Further studies are needed involving homogenous racial/ethnic populations examining household environmental factors found in this review, such as parental modeling of healthful and unhealthful eating behaviors, food preparation and kitchen restrictions, availability and accessibility, parenting practices, and parental consumption, and found in other studies, such as family connectedness,[69] feeding style,[70] and parent educational background.[71]

Research on the behaviors parents use to promote fruit and vegetable consumption is needed to fully understand the household food environment. Parental practices within the household social environment may impact fruit and vegetable consumption by children. Types of parenting practices found in this review were inter-correlated,[62] thus research on how parents use parenting practices in consort may lead to greater understanding of this factor in fruit and vegetable consumption by African American children. Child participation in and manner of preparation of fruits and vegetables and parental fruit and vegetable consumption may be important targets for future research. With limited food preparation skills,[57] research on identifying experiential strategies to promote fruit and vegetable consumption is needed. Methods of preparing food are important to food preferences and consumption by children.[72] Parental fruit and vegetable consumption has been reported as a positive correlate to

child fruit and vegetable consumption in previous reviews[42,46,47] and only one study within this review examined the parental consumption variable.[62] Additional studies with African Americans as the primary target population are needed to clarify the relationship between parent and child fruit and vegetable consumption in this population.

Despite the qualitative suggestion of the role of parent or grandparent modeling in the fruit and vegetable eating behavior of children,[56,57,59] it was not quantitatively examined in the studies included in this review. Previous reviews found a positive association between children's fruit and vegetable consumption and parental modeling.[42,47] Future studies on sociocultural factors within the household should include an exploration of parental modeling as a variable influencing fruit and vegetable consumption by children.

Strengths and Limitations of the Review

Food frequency questionnaires and 24-hour recall were used to assess dietary consumption in the included studies. There are limitations associated with these measurement tools including dependence on parent and/or child memory and over- and under-reporting of diet.[73] Validity and reliability are also limitations as they are accounted for in the appraisal of the quality of published studies. Reliability was more often reported in the studies included in this review than validity. Most studies included in this review used parental and child self-reported data. Self-reported data are subject to information bias based on comprehension, attention, and recall. Another limitation is parental report of both their own consumption of fruits and vegetables and children's consumption. Additionally, nearly all of the diet-related consumption measures were

administered by an interviewer. Recording error and the tendency of interviewers to prejudice responses toward a desired result in the absence of a standardized protocol are possible limiting factors in drawing conclusions from the results reported in the literature.

Few published studies in peer-reviewed journals address household environmental factors of fruit and vegetable consumption with a primary African American participant population. Most factors examined in this review were only found in two or less studies. Due to the paucity of studies on this topic and population, drawing conclusions regarding the consistency of associations is limited. The cross-sectional design of the quantitative studies included in this review also prohibits conclusions of causality and directional relationships drawn from the extracted data. Few studies reported significant associations between consumption and household environmental factors. Limitations in measurement or sample size may account for this finding.

A strength of this review is the inclusion of both qualitative and quantitative non-intervention studies describing household factors influencing fruit and vegetable consumption. Qualitative studies provide a means to collect data on subjective attitudes, beliefs, and values concerning behavior. At the same time, quantitative data, through survey research, can examine the prevalence of qualitatively analyzed attitudes, beliefs, values, and behaviors and to explore relationships among variables previously expressed during interviews or focus group discussions.[56] The distinct usage of qualitative and quantitative studies, coupled with African American children as the target population,

makes this systematic review unique among present reviews on fruit and vegetable consumption and household environmental-level influences.

Conclusions

The household environment, a setting where children spend a considerable amount of time, contributes greatly to the learning and practice of diet-related behaviors.[45] A clear consensus regarding household environmental influences on fruit and vegetable consumption has yet to emerge.[74] The scarcity of research on household environmental factors related to fruit and vegetable consumption by African American children precludes the ability of this review to provide conclusions based on replication and consistency of current evidence. The limited number of studies included in this review found home availability, participation in food preparation, parental modeling, allowance/pocket money, and kitchen restrictions as factors within the physical, sociocultural, economic, and political household environments influencing fruit and vegetable consumption. Home availability and allowance/pocket money were positively associated with children's consumption of fruits and vegetables.

This review underscores the need for further investigation of environmental factors related to fruit and vegetable consumption. More specifically, additional research focusing strictly on factors influencing the diet of African American children. Newly developed interventions for African American children should concentrate on objectives incorporating the assessment and promotion of factors found in this review. Interventions should also explore additional variables from previous systematic reviews[42,46,47] and factors not found within the current literature.

So What?

Identifying the influences of dietary behaviors is of critical importance to the formation of intervention programs to combat the major contributors to higher overall mortality and obesity-related morbidity rates among African Americans.[75,76] Dietary behaviors, such as fruit and vegetable consumption, may be of importance to the prevention and reduction of obesity. Increasing overall consumption of fruits and vegetables must include the identification of factors directly related to the proximal environment of children, namely the household. As childhood obesity prevention and intervention strategies become a national public health priority,[20] consolidating current literature on contributory factors of obesity to inform these strategies becomes more critical. This review found household environmental factors in the literature (e.g., home availability of fruits and vegetables, child participation in food preparation) contributing to the overall fruit and vegetable consumption by African American children. However, additional research is needed.

CHAPTER III

ASSESSMENT OF DIET QUALITY OF LOW-INCOME AFRICAN AMERICAN WOMEN AND CHILDREN

Overview

Overall diet quality in the United States continues to need improvement, particularly among African Americans. The purpose of this study was to describe the diet quality of low-income African American women and children and to examine the relationships between ecologically-based sociodemographic factors. A healthy food indicator with four components indicative of a healthy diet, fruits, vegetables, whole grains, and low-fat milk, was used to measure diet quality. Data from a national survey of Women, Infants and Children (WIC) participants were used to conduct separate analyses for women and children. African American women and children did not meet the standards for a healthy diet. Personal and family characteristics, including age, sex, caregiver education, urbanization, and region of residence are associated with diet quality in African American women and children. Health education strategies aimed at improving diets of African Americans need to address a variety of sociodemographic factors influencing dietary behavior patterns.

Introduction

Chronic conditions are on the rise in minority populations in the United States, including African Americans.[1,77-80] The over-consumption of fat and saturated fat and under-consumption of foods containing fiber and calcium, namely fruits, vegetables,

whole grains, and low-fat milk, are associated with obesity, coronary heart disease, stroke, diabetes, hypertension, osteoporosis, and some forms of cancer.[81] A large body of evidence demonstrates the benefit of following a diet recommended by the USDA *Dietary Guidelines for Americans*[82] in reducing chronic disease risk and promoting overall health for all ages.

Overall diet quality is the extent of adherence to dietary standards based on individual food choices.[83] Index- or score-based tools are used to measure diet quality and are generally based on dietary recommendations to reduce the risk of chronic conditions. The development of diet quality assessment tools has gained considerable prominence among researchers.[84] Dietary indices have advantages over traditional multivariate statistical approaches. Diets are complex and consist of highly correlated food components, thus an analysis of separate food groups on health outcomes can prove difficult. Adopting a dietary index through combining the consumption of food groups is a technique more amenable to an accurate evaluation of diets than single food component analysis.[85]

A variety of indices differing in components, values used for standards, and scoring methods are described and used in the literature.[86-91] Studies of the determinants of diet quality and associations between diet quality and health outcomes have shown indices are associated with nutrition knowledge, demographic and socioeconomic factors, nutritional biomarkers of micronutrients, body mass index, cardiovascular disease risk and mortality, and breast and colorectal cancer risk.[92-99]

The eating patterns of Americans are inconsistent with recommendations to prevent adverse health outcomes. The consumption of fruits, vegetables, whole grains, and dairy products are on average lower than recommended.[100,101] Fungwe et al[14] reported the diet of children of all ages were less than optimal with total Healthy Eating Index (HEI-2005) scores between 54.7 and 59.6 out of 100 possible points and a mean score of 55.9. A mean total HEI-2005 score of 58.2 out of 100 was reported in adults.[102] Obtaining a score of 80 out of 100 is considered by the USDA to be a healthy diet for the HEI.[103] In a report of HEI-2005 scores estimated from the 2003-2004 National Health and Nutrition Examination Survey (NHANES), diet quality among low-income adults and children over 2 years-of-age were lower than those with higher incomes. Total vegetables, dark green and orange vegetables and legumes, and whole grains component scores were significantly different between low-income and higher income groups.[104]

The current gap in literature on measures of diet quality for populations from ethnically and socioeconomically diverse backgrounds leads to the selection of African American women and children as the population of interest for this study.[105] Increasingly, the diet of economically disadvantaged and African American populations is seen as a contributory factor in poor health outcomes and environmental factors (e.g., access to healthful foods) influence diet.[8,106,107] The primary purpose of this study was to examine the diet quality of low-income African American women and children based on fruit, vegetable, whole grain, and milk consumption and to identify sociodemographic factors from the ecological perspective— a perspective seeking to understand the nature of people's transactions with their surroundings— related to diet quality.[108]

Methods

Data Source and Study Population

In this study, we analyzed data collected for a national cross-sectional assessment of food consumption, food preferences, behavioral intentions, and sociodemographics of participants in the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC). The purpose of the original study was to evaluate diet-related behaviors of WIC participants prior to the implementation of revisions to the WIC food packages in October 2009. Participants were recruited from WIC clinics in 39 states and 13 Indian tribal organizations, U.S. territories, and the District of Columbia from February to August 2009. Sampling protocols were adapted for each state to provide a study sample from a variety of intra-state regions and a representative sample of racial/ethnic and WIC eligibility categories. Inclusion criteria for this study included being a non-Hispanic, black child aged 2 to 5 years or non-Hispanic, black woman of any age. After excluding respondents not meeting inclusion criteria, the final sample consisted of 3,006 women and 2,890 children.

The National Food and Nutrition (NATFAN) questionnaire was developed by the Institute for Obesity Research and Program Evaluation at Texas A&M University in collaboration with the National WIC Association's Evaluation Committee, the USDA Economic Research Service, and FNS Office of Research, Nutrition & Analysis. The questionnaire was a modified version of a food and nutrition questionnaire implemented in Texas in 2009. The NATFAN questionnaire contained 3 sections: 1) Woman, 2) Infant, and 3) Child. Each section was administered separately and completed by WIC

participants (e.g., primary caregivers). No data to directly link the "Woman" and "Child" sections were available.

Measures

Sociodemographics

Bergner's model of health status[109] was used to guide the selection of sociodemographic factors in this study. The model is theoretically grounded in the ecological perspective and details the different levels of environmental influence on health status. The levels of influence include personal, social and familial, and societal and health care system factors. For the purpose of this study, the sociodemographic factors were selected and classified into two levels of influence, personal and family factors. Sociodemographic factors differed for women and children. Personal factors for women included age and education and family factors included region of residence and urbanization. Personal factors for children included age and sex and family factors included U.S. region of residence, urbanization, and caregiver education.

Fruit and Vegetable Consumption

Fruit, vegetable, whole grain, and milk consumption frequencies were the main focus of this study. These variables were assessed using food frequency questions modified from the Behavioral Risk Factor Surveillance System (BRFSS)[110] and original items to the NATFAN questionnaire. Fruit, vegetable, and whole grain consumption items were on a scale from 'never or less than once per week' to '4 or more times per day.' One-half of the 6 answer categories on the scale were 'per week' (e.g. 1 to 3 times per week) and the other half were 'per day' (e.g. 2 times per day). Milk consumption

was measured based on an item that asked the respondent the number of cups of milk consumed each day. The scale for this item included 'I do not drink milk,' 'less than 1 cup,' '1 cup,' '2 cups,' '3 cups,' and '4 or more cups.' The final item asked about the kind of milk consumed by the respondent and child. The answer categories included 'whole milk' and low-fat options like '2% milk' and 'skim milk (fat free).'

Healthy Food Indicator

We created a healthy food indicator a priori on the basis of current food recommendations from the *Dietary Guidelines*.[82] The methodology used to develop the healthy food indicator followed the guidance of Kourlaba and Panagiotakos[111] for index development. The indicator was constructed to assess overall diet quality and adherence to recommendations for foods shown to reduce the risk of a variety of chronic diseases, such as obesity, and emphasized in the *Dietary Guidelines*. The food groups included fruits, vegetables, whole grains, and low-fat milk. Although protein is an important component in the diets, the majority of Americans consume enough of this food group and strategies are not needed to increase consumption.[82]

The healthy food indicator was modeled after the Elderly Dietary Index (EDI) developed by Kourlaba et al.[112] The EDI was developed to include ten components (e.g., meat, vegetables, cereals, dairy, bread) based on the Modified MyPyramid for Older Adults. The scoring system for the EDI included 1 to 4 points for each food component in the index. The scoring system to assign each component score was based on guidelines for older adults and research on food and chronic disease associations.

Dietary data from a food frequency questionnaire to assess dietary habits of older adults were used to apply the index.

Similar to the EDI, the healthy food indicator recorded consumption frequencies of each food group using scores from 1 to 4 points. To adjust for energy needs, appropriate points were assigned based on age and sex recommendations outlined in the *Dietary Guidelines*. For fruits, vegetables, and whole grains, an individual component score of 4 points indicated adherence to recommended daily consumption and a score of 1 point indicated non-adherence (Table 3.1, Table 3.2). No extra credit or penalties were given for the consumption of any food group beyond the recommended amount. The milk component score was divided into two equal scores of 2 points for a total of 4 points. One-half of the component score was based on the frequency of consumption of the recommended servings of milk. The other 2 points were based on the consumption of low-fat milk. The maximum points were given if low-fat or fat free milk was usually consumed, while 1 point was given if no milk or whole milk was consumed. The maximum cumulative score for all four components of the healthy food indicator was 16 points. A complete listing of all scoring standards is presented in Appendix B.

Table 3.1
Healthy Food Indicator Components[a] and Standards for Scoring for Women

Food Component	Maximum points	Standard for maximum score	Standard for minimum score of 1
Age			
17 or younger			
Fruits	4	≥3 times/day	<3 times/wk
Vegetables	4	≥4 times/day	<3 times/wk
Whole Grains	4	≥4 times/day	<3 times/wk
Milk[b]	2	≥3 cups/day	No milk
	2	low-fat or fat-free milk	No milk or whole milk
18-29 years			
Fruits	4	≥4 times/day	<3 times/wk
Vegetables	4	≥4 times/day	<3 times/wk
Whole Grains	4	≥4 times/day	<3 times/wk
Milk	2	≥3 cups/day	No milk
	2	low-fat or fat-free milk	No milk or whole milk
30 or older			
Fruits	4	≥3 times/day	<3 times/wk
Vegetables	4	≥4 times/day	<3 times/wk
Whole Grains	2	≥4 times/day	<3 times/wk
Milk	2	≥3 cups/day	No milk
	2	low-fat or fat-free milk	No milk or whole milk

[a] Components were based on the frequency of consumption of fruits, vegetables, whole grains, and fluid milk products.
[b] Included the frequency of consumption of fluid milk products and milk type.

Table 3.2
Healthy Food Indicator Components[a] and Standards for Scoring for Children

Food Component	Maximum points	Standard for maximum score	Standard for minimum score of 1
Male			
Age			
24-47 months			
Fruits	4	≥2 times/day	<3 times/wk
Vegetables	4	≥2 times/day	<3 times/wk
Whole Grains	4	≥3 times/day	<3 times/wk
Milk[b]	2	≥2 cups/day	No milk
	2	low-fat or fat-free milk	No milk or whole milk
48-60 months			
Fruits	4	≥3 times/day	<3 times/wk
Vegetables	4	≥3 times/day	<3 times/wk
Whole Grains	4	≥4 times/day	<3 times/wk
Milk	2	≥2 cups/day	No milk
	2	low-fat or fat-free milk	No milk or whole milk
Female			
Age			
24-47 months			
Fruits	4	≥2 times/day	<3 times/wk
Vegetables	4	≥2 times/day	<3 times/wk
Whole Grains	4	≥3 times/day	<3 times/wk
Milk	2	≥2 cups/day	No milk
	2	low-fat or fat-free milk	No milk or whole milk
48-60 months			
Fruits	4	≥2 times/day	<3 times/wk
Vegetables	4	≥3 times/day	<3 times/wk
Whole Grains	2	≥4 times/day	<3 times/wk
Milk	2	≥2 cups/day	No milk
	2	low-fat or fat-free milk	No milk or whole milk

[a] Components were based on the frequency of consumption of fruits, vegetables, whole grains, and fluid milk products.
[b] Included the frequency of consumption of fluid milk products and milk type.

Statistical Methods

The SPSS 16.0 software package for Windows (SPSS, Chicago, IL) was used to recode and analyze the variables of interest. Each sample was divided into three groups. The low-, mid-, and high-level groups were based on the rank ordering of overall healthy food indicator scores. For example, dietary consumption by women and children classified into the high group would have adhered to the *Dietary Guidelines* to a greater extent than those in the mid- and low-level groups. Descriptive measures such as frequencies, means, medians, and 95% confidence intervals of component scores and tertiles were calculated. Ordinal logistic regression analysis was performed to describe the characteristics of the healthy food indicator scores. The outcome variable in the analysis was the healthy food indicator score denoted as ordered tertiles. The ordinal logistic model was used to describe the relationship between healthy food indicator groups and sociodemographic factors, including age, sex, education, U.S. region of residence, and urbanization. Odds ratios were estimated for high- and mid-level healthy food indicator scores with the low group as the reference in the model. All analyses were preformed separately for women and children.

Results

The majority of the women in the study sample was aged 18 to 23 years (38.2%) and had more than a high school education (42.4%). The proportions of male and female children were 48.2% and 50.2%, respectively. The age range most represented in the study sample for children was 24 to 35 months (42.8%). Women and children overwhelmingly resided in urban settings and in the South.

The majority of children had a healthy food indicator score between 11 and 13 and the majority of women had scores between 8 and 10 (Table 3.3). The average healthy food indictor score was lower for African American women than children, with mean scores of 8.88 (95% confidence interval [CI] 8.79 to 8.98) and 11.05 (95% CI 10.95 to 11.16), respectively. Based on the mean scores, women were 56% (8.88 of 16) adherent to recommendations for fruit, vegetable, whole grain, and milk consumption. Children had a more healthful diet as 69% (11.05 of 16) consumed recommended levels of the 4 food groups. Stratifying the data by children's sex, the mean overall healthy food indicator scores were 11.02±0.8 (mean±standard error) for males and 11.09±0.08 for females.

Table 3.3
Distribution of Women (n=3006) and Children (n=2890) by Healthy Food Indicator Level

HFI[a] score	No.	%
Children		
≤7	317	11.0
8-10	824	28.5
11-13	945	32.7
≥14	804	27.8
Women		
<7	954	31.7
8-10	1094	36.4
11-13	761	25.3
≥14	197	6.6

[a] HFI – healthy food indicator.

Table 3.4 presents the component scores and the percentage of women and children with the minimum and maximum scores for each food group. Children adhered to the dietary guidance for milk more than any other food group. This was consistent among female (2.86±0.03), but not among male children. The highest mean component score for male children was whole grains (2.88±0.03). For the remaining components, the mean scores for fruits (2.82±0.03) and vegetables (2.56±0.03) for female children were higher than the mean scores for fruits (2.73±0.03) and vegetables (2.52±0.03) for

Table 3.4
Healthy Food Indicator Component Scores and Minimum and Maximum Score Percentages for Women and Children

HFI[a] components	Mean	95% CI[b] (mean)	Adherence (%)	Score 1 (%)	Score 4 (%)
Children					
Fruits	2.78	2.73-2.82	69.5	21.7	41.4
Vegetables	2.54	2.50-2.59	63.5	28.3	31.0
Whole grains	2.87	2.83-2.91	71.8	16.3	37.8
Milk	2.88	2.83-2.90	72.0	10.6	35.1
Total HFI	11.05	10.95-11.16	69.1		
Women					
Fruits	2.30	2.27-2.34	57.5	28.3	15.8
Vegetables	2.08	2.05-2.12	52.0	31.7	8.1
Whole grains	2.57	2.53-2.61	64.3	21.9	29.2
Milk	1.92	1.89-1.96	48.0	47.1	8.7
Total HFI	8.88	8.79-8.98	55.5		

[a] HFI – healthy food indicator.
[b] MSA – metropolitan statistical area.

male children. The mean score difference between the male and female children was significant for fruits (t=-1.93; p=0.05), but not for vegetables (t=-0.79; p=0.43). African American women had the highest component mean score for whole grains (2.57±0.02). The lowest mean component score among women was milk (1.92±0.02) and the lowest was vegetables for children (2.54±.02).

Table 3.5 and Table 3.6 illustrate the characteristics of women and children by tertiles of their overall healthy food indicator score. Women with higher diet quality scores, an indication of greater adherence to dietary recommendations, were between 18 and 23 years and primarily resided in the South and in urban settings. Children in the group with higher scores were more likely to be between 24 and 35 months, live in urban setting and in the southern region, and have a caregiver with more than a high school education.

Table 3.5
Descriptive Characteristics of Women by Healthy Food Indicator Scores

Sociodemographic characteristics	Tertiles of HFI[a] Low (4-7)	Mid (8-10)	High (11-16)	*p* value
	n (%)			
Participants	954 (31.7%)	1094 (36.4%)	958 (31.9%)	
	%			
Personal factors				
Age				<0.001
17 or younger	6.60	5.30	5.53	
18-23 years	41.61	41.13	36.01	
24-29 years	35.22	36.47	32.88	
30 or older	16.56	21.21	25.58	
				0.098
Education				
Less than high school	22.85	17.91	21.09	
High school graduate/GED	38.16	37.20	35.91	
More than high school	38.99	45.43	43.00	
Family factors				
Region of residence				<0.001
Northeast	12.05	15.36	14.30	
West/Midwest	13.63	20.66	19.03	
South	74.32	63.99	63.15	
Urbanization				0.002
MSA[b] (urban)	88.68	91.59	92.69	
Non-MSA (rural)	11.32	8.41	7.31	

[a] HFI – healthy food indicator.
[b] MSA – metropolitan statistical area.

Table 3.6
Descriptive Characteristics of Children by Healthy Food Indicator Scores

Sociodemographic characteristics	Tertiles of HFI[a] Low (4-9)	Mid (10-12)	High (13-16)	*p* value
	n (%)			
Participants	999 (34.6%)	934 (32.3%)	957 (33.1%)	
	%			
Personal factors				
Age				<0.001
24-35 months	41.34	41.33	45.77	
36-47 months	30.23	31.80	35.42	
48-59 months	28.43	26.87	18.81	
Sex				0.509
Male	50.49	49.79	48.98	
Female	49.51	50.21	51.02	
Family factors				
Region of residence				0.026
Northeast	16.01	18.42	17.66	
West/Midwest	20.12	22.59	24.56	
South	63.86	58.99	57.78	
Urbanization				<0.001
MSA[b] (urban)	85.99	87.58	91.54	
Non-MSA (rural)	14.01	12.42	8.46	
Education of caregiver				0.007
Less than high school	16.02	14.78	14.42	
High school graduate/GED	41.74	37.47	36.26	
More than high school	42.24	47.75	49.32	
Age of caregiver				0.041
23 or younger	22.62	18.84	19.54	
24-29 years	43.54	43.46	42.63	
30-34 years	15.71	16.27	17.45	
35 or older	18.12	21.41	20.38	

[a] HFI – healthy food indicator.
[b] MSA – metropolitan statistical area.

Sociodemographic Factors Associated with Healthy Food Indicator Scores

The relationships between the healthy food indicator and sociodemographic characteristics are depicted in Table 3.7 and Table 3.8 separately for women and children. For women, the statistically significant factors were age (personal factor) and region of residence and urbanization (family factors). Women under the age of 17 were 61% less likely to have low diet quality than women over age 30 (OR=-0.39; 95% CI -0.73 to -0.04). Women aged 18-23 years were 59% less likely to have a lower diet quality than women over age 30 (OR=-0.41; 95% CI -0.60 to 0.23), while women 24-29 years old were 63% less likely to have low diet quality than women over 30 (OR=-0.37; 95% CI -0.56 to -0.2). Women residing in the West/Midwest were 0.45 times as likely to have diet quality in the lowest category as women residing in the South (OR=0.45; 95% CI 0.28 to 0.63). For urbanization, the odds of women residing in urban areas having low diet quality was 77% lower than rural women (OR=0.23; 95% CI -0.01 to 0.47).

The statistically significant factors for children were age (personal factor) and urbanization and caregiver education (family factors). Children aged 24-35 months were 62% less likely than children over 4 years old to have low diet quality (OR=0.38; 95% CI 0.21 to 0.55). The odds of children 36-47 months having low diet quality was 59% lower than children over 4 years old (OR=0.41; 95% CI 0.23 to 0.59). Children who were urban residents were 69% less likely than rural residents to have diet quality in the lowest category (OR=0.31; CI 0.1 to 0.53). Children of caregivers who reported having

a high school diploma were 80% less likely to have low diet quality than children of caregivers with more than a high school education.

Table 3.7
Relationship of Total Healthy Food Indicator Scores and Sociodemographic Factors for Women

Sociodemographic characteristics	Odds Ratio	95% Confidence Interval	
		Lower	Upper
Personal factors			
Age			
17 or younger	-0.385	-0.728	-0.041
18-23 years	-0.412	-0.595	-0.229
24-29 years	-0.374	-0.557	-0.191
30 or older	—	—	—
Education			
Less than high school	-0.064	-0.261	0.133
High school graduate/GED	-0.059	-0.209	0.092
More than high school	—	—	—
Family factors			
Region of residence			
Northeast	0.179	-0.017	0.375
West/Midwest	0.452	0.278	0.627
South	—	—	—
Urbanization			
MSA[a] (urban)	0.233	-0.003	0.470
Non-MSA (rural)	—	—	—

[a] MSA – metropolitan statistical area.

Table 3.8
Relationship of Total Healthy Food Indicator Scores and Sociodemographic Factors for Children

Sociodemographic characteristics	Odds Ratio	95% Confidence Interval	
		Lower	Upper
Personal factors			
Age			
24-35 months	0.381	0.209	0.553
36-47 months	0.407	0.226	0.588
48-59 months	—	—	—
Sex			
Male	-0.079	-0.214	0.055
Female	—	—	—
Family factors			
Region of residence			
Northeast	0.081	-0.106	0.268
West/Midwest	0.165	-0.006	0.335
South	—	—	—
Urbanization			
MSA[a] (urban)	0.313	0.095	0.531
Non-MSA (rural)	—	—	—
Education of caregiver			
Less than high school	-0.164	-0.365	0.037
High school graduate/GED	-0.197	-0.345	-0.049
More than high school	—	—	—
Age of caregiver			
< 23 years	-0.206	-0.421	0.009
24-29 years	-0.101	-0.284	0.081
30-34 years	-0.019	-0.243	0.205
35 or older	—	—	—

[a] MSA – metropolitan statistical area.

Discussion

Researchers have developed a variety of indices to assess diet quality.[113,114] Each index has used different components and dietary standards to create a tool to assess quality of diets in specific populations. Consuming fruits, vegetables, whole grains, and low-fat or fat-free milk in amounts suggested by the *Dietary Guidelines* provides adequate amounts of nutrients (e.g., fiber, calcium, potassium, vitamins A, C, D, and E, magnesium) needed for proper bodily functioning and prevention of chronic disease. In this study, a healthy food indicator based on current recommendations of the *Dietary Guidelines* was created a priori. Since the healthy food indicator components were based on the four recommended food groups, the measure provided a simple standard for the evaluation of diet quality.

The purpose of this study was to explore the relationship between diet quality and sociodemographic factors to identify factors influencing the quality of diets among low-income African American women and children. Sociodemographic factors were selected based on Bergner's model of health status,[109] including age, education (women), and sex (children) as personal factors and region of residence, urbanization, caregiver education (children) as family factors. Relationships between the overall healthy food indicator score used to assess diet quality and personal and family factors of African American women and children were identified from a national survey of WIC participants.

As an ecologically-based model, the dimensions of Bergner's model of health status were explained through the lens of the environment, including societal, social and

familial, and personal factors. These dimensions are similar to the five levels of environmental influence— intrapersonal, interpersonal, institutional, community, and public policy— described by McLeroy and colleagues.[43] Using the ecological perspective to guide the selection of sociodemographic factors provided clear direction and maximization of explanatory variables within the secondary data. The associations found in this study for personal and family factors and diet quality gives further insight into how specific levels of environmental influence affect the diets of African American women and children.

The overall mean healthy food indicator score for African American women was 8.88 out of a possible score of 16 and the mean score of African American children was 11.05 out of 16. A greater proportion of children adhered to recommended guidelines than women. This finding is consistent with reported diet quality among African American women and children by age. Basiotis et al[115] reported a lower mean overall HEI score for African American women than children under 6 years old. Conversely, Cole and Fox[116] reported a higher mean overall HEI-2005 score for women participating in Federal food assistance programs and income-eligible nonparticipants than for children in the same two categories. However, the overall index scores for children in the Cole and Fox report was not separated by age group. Younger children tend to have diets closer to dietary recommendations than adolescents.[91,117] The discrepancy between the index scores of women and children in the two studies may be due to the age of the children.

The complexity of dietary patterns is exhibited in the overall scores produced by the healthy food indicator. Consuming one food component to dietary standards does not result in a high overall score. In other words, no one single component is of greater importance to the healthy food indicator than any other. Less than ideal overall diet quality scores for African American women and children are driven by all four components contributing to the index.

Adherence to recommendations for specific healthy food indicator components were greater than expected for both African American children. Children met recommendations for milk and whole grains the most with 72% adherence for both components. Carlson et al[15] reported a much lower percentage of children meeting the dietary recommendations for milk and whole grains and milk was not among the highest component scores. Children consumed more fruits than vegetables with 70% and 64% adherence, respectively. This is consistent with much of the current literature on fruit and vegetable consumption among children.[61,118-120] Children often report less taste preference for vegetables than for fruits.[58] Worobey et al[121] found both male and female children aged 3 to 4 years children liked a greater proportion of fruits than vegetables. Since food preferences are established in early childhood and persist as children age, this difference between fruit and vegetable consumption by children is problematic.[122]

African American women also had greater healthy food indicator component scores than expected, albeit less than children. Women had the greatest adherence to dietary recommendations for whole grains (64%) and fruits (58%). The higher proportion of adherence to recommendations for whole grains is consistent with other

diet quality indices applied to diets of African Americans.[115,123] Women had the lowest adherence to recommendations for low-fat and fat-free milk consumption with 48% adherence. Milk and milk products provide protection against many chronic diseases, including obesity, diabetes, osteoporosis, and some forms of cancer. Additionally, milk consumption can reduce blood pressure and promote gut health.[124] Although milk is beneficial to overall health, a great majority of adults do not consume milk and milk products often due to a variety of reasons.[125] Those with genetic admixture proportions from Africa, Asia, and the Americas refrain from the consumption of even moderate amounts of milk due to lactose intolerance.[126] On average, African American lactose intolerant women consume significantly lower amounts of calcium through milk and milk products than do those who are tolerant.[127]

In general African American women and children in this study had greater adherence to dietary recommendations than predicted. An explanation for the increased consumption may be a result of the respondents' participation in the WIC program in their respective states. In a study of WIC participants, Basiotis et al[128] found a very strong positive effect between WIC participation and diet quality. Duffy et al[129] did not find a positive relationship between diet quality and WIC participation; however, positive relationships were found for specific components, including fruit and whole grains. The WIC program provides nutrition education and food packages to participants. Either one of these programmatic services may have an effect on the food group component and overall diet quality scores for women and children presented in this study.

The food environment experienced by rural, low-income families is different than families living in densely populated urban and suburban settings. The distribution of and access to food is unequal in the United States.[130] Places where few or no food sources are available for purchase are termed food deserts.[131] On average, rural counties have 3.8 grocery stores.[132] Easy access to grocery store shopping is associated with increased household use of food groups, including fruits and vegetables, and overall diet quality.[132-134] In this context, the relationship between urbanization and diet quality were as expected. Urbanization was associated with diet quality for both African American women and children. Those who resided in urban settings were less likely to have diet quality in the lowest category.

African American women and children of younger ages were less likely to have low diet quality than those of those over 30 years- and 4 years-old, respectively. The results for children coincide with other research showing a decline in diet quality as children get older.[135,136] However, the finding for women is unexpected as others have shown an increase in diet quality as women age.[101] Forshee and Story[137] examined relationships between diet quality using HEI scores and a variety of demographic characteristics. Results showed an association between age and diet quality, whereby women in older age categories had increasingly higher diet quality.

Children of high school graduates were less likely to have low diet quality than children of caregivers with more than a high school education. This is the opposite finding for caregiver education than Goodwin et al[138] who reported adolescents whose parents had a high school education were more likely to have lower diet quality. In

addition, higher parental education is associated with greater health consciousness regarding food choices.[139] Coupled with research showing diet quality increases as level of education increases from no high school to attended high school among African American women, the relationship between diet quality and caregiver education in this study is surprising.[140]

There are several limitations of this study. The survey instrument included food frequency questions to elicit information on individual consumption of certain foods. Food frequency questionnaires are often used because they are easily administered at a low cost; however, these measures have many limitations.[141] Cognitively, questions on usual frequency of consumption are difficult for respondents to answer, leading to measurement error. In general, dietary data is error prone due to daily variability in food consumption and the difficulty respondents have in recalling what they consume. Data used for this study were derived exclusively from reports of women, both of their own food consumption and sociodemographic characteristics and those of children. However, for preschool aged children, parents and caregivers are considered the best reporters of children's consumption patterns.[142,143] Regardless of the designated respondent, biased under- or over-reporting of consumption for psychosocial reasons, such as social desirability, is always a possibility.

The use of secondary data for this study restricted the ability to include more behaviors and factors of potential importance in influencing dietary behaviors. A limited number of foods were included in the NATFAN questionnaire and no detail about food preparation practices was collected. The food frequency questions were based on usual

portion size, which may be problematic for highly variable foods that take on many forms, like vegetables. The original study was cross-sectional, thus data were based on a single report of usual consumption rather than capturing the same respondents over multiple time periods. Recording consumption data over time may have proven to create a more robust assessment of diet quality.

The study consisted entirely of a non-random sample of African American WIC participants, thus the results are not generalizable. No conclusions can be drawn on whether the women and children in this study have better, worse, or comparable diets to all low-income African American women and children in the United States.

Further research is needed to determine the utility of the healthy food indicator developed for this study. Developing the content of indices is complex and includes a great deal of subjectivity in the selection of components and cut-off values and scoring. Thus, validation of diet quality scores is needed through the determination of relationships between overall scores and nutrition adequacy or health outcomes.[144,145] The use of the healthy food indicator in future studies to determine its association with chronic conditions, such as obesity, can determine validity. Furthermore, it is also necessary to use the healthy food indicator in studies of other populations, such as Hispanic or non-Hispanic, white WIC participants, to validate the usefulness of the indicator in populations with varying dietary patterns.

Conclusions

Comparable to most Americans, the overall diet of low-income African American women and children continues to need improvement. These findings have

implications for the development of health education strategies to improve dietary behaviors as personal and family factors, including age, sex (children), region of residence, urbanization, and caregiver education (children) were significantly related to diet quality. All African American women and children would benefit from health education on the importance of consuming the recommended daily amounts of fruits, vegetables, whole grains, and low-fat milk. Future studies using measures of diet quality, such as the healthy food indicator, can contribute to improved diets among African Americans. By providing a greater understanding of dietary patterns, measures of diet quality can assist health educators in promoting more specific and comprehensive education to African American women and children.

CHAPTER IV

UNDERSTANDING HOUSEHOLD ENVIRONMENTAL FACTORS AND FRUIT AND VEGETABLE CONSUMPTION BY AFRICAN AMERICAN CHILDREN

Overview

To understand the relationship between household environmental factors and fruit and vegetable consumption by children, the authors examined data from food and nutrition questionnaires completed by 227 African American female primary caregivers participating in the Women, Infants, and Children (WIC) program in Texas. The majority of children did not meet the current dietary recommendations for daily fruit and vegetable consumption. Six household environmental factors based on elements of the ANGELO framework were associated with fruit and vegetable consumption by children, including physical factors (primary caregiver purchase and preparation of fruits and vegetables) and sociocultural factors (primary caregiver fruit and vegetable consumption, perception of child liking fruits and vegetables, fruit and vegetable selection self-efficacy, and self-efficacy for healthful child feeding). The strongest predictor of fruit and vegetable consumption by children was the fruit and vegetable consumption by primary caregivers. Intervention strategies to promote the reduction of childhood obesity through increases in fruit and vegetable consumption must account for the consumption of fruits and vegetables among primary caregivers.

Introduction

Texas has one of the highest obesity rates for low-income preschool-aged children among all states in the United States. The obesity prevalence among children aged 2 to 4 years in Texas participating in the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) in 2008 was 16.2%, a 1.8 percentage point change from 2003.[23] Obesity in children is problematic since obese children are more likely to become obese adults and obesity-related chronic conditions in children and adults continue to rise.[106,146-148]

Obesity among African American children is of particular concern due to disparities in chronic disease morbidity and mortality in African American adults.[75] Four out of five African American women are overweight or obese.[1] The prevalence of obesity is higher in African American women than all other racial/ethnic and gender groups.[149] Similar to obesity rates among African American women, obesity among African American children is more pronounced in comparison to other race/ethnicity subgroups. Nearly 50% more 2- to 5-year-old African American children are overweight or obese than white children (17.4%) in the same age range.[2] Given current obesity trends among African American children and adults, the obesity epidemic will likely worsen if steps are not taken to intervene. The body of evidence on successful obesity interventions is limited despite the continued need for effective approaches to prevent obesity and obesity-related conditions.[150,151]

Diets rich in fruits and vegetables are associated with reduced risk of many chronic diseases, including obesity.[33,152] For almost twenty years, a major nutrition

campaign has urged Americans to increase the variety and quantity of fruits and vegetables consumed.[153] Despite these recommendations, few children or adults, particularly those of low-income households, currently meet the minimum requirement for daily fruit and vegetable consumption.[104,154,155]

Personal, environmental, and behavioral factors are interconnected and influential in dietary behavior and the resulting health outcomes (e.g., obesity).[130] Traditionally, the influence of personal level factors on childhood obesity was emphasized in research; however, the recognition of family and environmental level factors as determinants of obesity have increased in recent literature.[156,157] Children first acquire health habits within the household environment, thus childhood obesity intervention programs must involve parents and should be developed from the perspective of the whole family environmental system.[19,158]

To institute effective interventions against childhood obesity, a better understanding of the factors underlying the epidemic is required. Since fruit and vegetable consumption is an important component in reducing obesity and obesity-related conditions and parents and caregivers are integral to the development of proper eating behaviors in children within the home, household environmental factors and children's fruit and vegetable consumption are the focus of this study.[19] The primary purpose of this study was to investigate potential household environmental factors influencing fruit and vegetable consumption by low-income African American children.

Methods

Sample and Data Collection

We used secondary data from the baseline implementation of the Texas WIC Food and Nutrition Questionnaire (TEXFAN) for this study. The purpose of the original cross-sectional study was to evaluate the diet-related behaviors of Texas WIC participants prior to inaction of revisions to the WIC food packages in 2009. A representative sample of Texas WIC participants were recruited with the assistance of 73 local agency directors representing 578 WIC clinics throughout Texas. The number of WIC participants sampled within each local agency was proportional to the percentage of WIC clients served, with a minimum of 50 participants sampled at each local agency. The final sample included 6,884 WIC program participants. The Institutional Review Boards at Texas A&M University and the Texas Department of State Health Services approved the study protocol. Informed consent was obtained from all participants through passive consent. The study presented here only focused on non-Hispanic, black female caregivers with children 1-year or older. After applying the exclusion criteria, the final sample included 227 primary caregivers and children.

The TEXFAN questionnaire was developed by the Institute for Obesity Research and Program Evaluation at Texas A&M University (the Institute) based on the objectives of the Texas Department of State Health Services. Two pilot tests and participant interviews were conducted prior to the implementation of the questionnaire to ensure measurement validity. The final iteration of the TEXFAN questionnaire included both English and Spanish versions and contained four sections, including family, adult, infant,

and child, with a total of 122 items. The sections of the questionnaire were collated into one instrument, thus allowing for the connection of parent and child data. The questionnaire measured food consumption behavior, food preferences, behavioral intentions, and sociodemographics.

Questionnaires were sent to all local agencies in Texas and were completed between November 2008 and February 2009. Local WIC clinic staff administered the questionnaires to WIC participants visiting the clinic during the administration period or attending a nutrition education class. English or Spanish versions of the TEXFAN questionnaire were administered based on the language preference of the participant. All complete, incomplete, and refused questionnaires were returned to the Institute for data processing, analysis, and reporting.

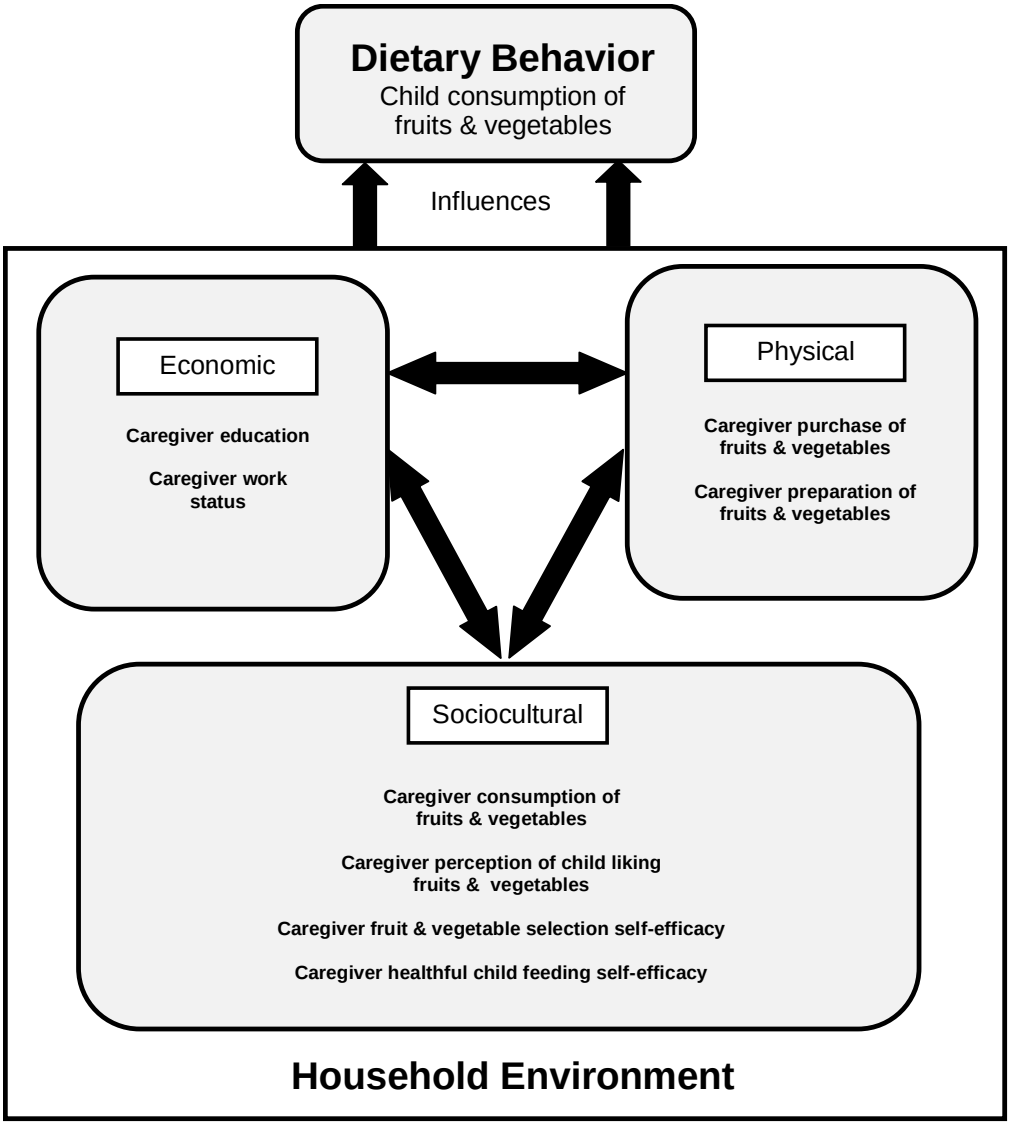
Description of Proposed Model and Measures

The ecological perspective is one approach to understanding current trends in fruit and vegetable consumption by children. Ecological models to understand health behaviors incorporate personal and environmental factors.[43] The environment has an important role in influencing behaviors by acting in support of, or as a hindrance to, health behaviors occurring within it.[159] The environment established by the family within households plays an important role in shaping what young children learn about food and eating.[16] Since children are restricted to decisions to eat or not eat the food available to them rather than decisions on what type or amount of food available, children's food consumption patterns are constrained by the environment.[41]

Researchers have developed several ecological models to explain obesity-related health behavior.[8,160,161] Swinburn et al[44] developed an ecological model to conceptualize the environmental influences of obesity. The ANGELO framework (Analysis Grid for Elements Linked to Obesity) dissects the environment into two environmental sizes— micro- and macro-level settings— and four environmental types— physical, economic, political, and sociocultural.[44] Within this ecological model, the household is considered a micro-environmental setting made up of physical (e.g., accessibility of foods), sociocultural (e.g., parenting practices), economic (e.g., parental occupation), and political (e.g., food rules) environmental types.

Eight household environmental variables reported by the African American primary caregivers in this study were selected as explanatory variables of fruit and vegetable consumption among children based on the ANGELO framework. Selected variables by environmental type include: 1) physical (primary caregiver purchase of fruits and vegetables and preparation of fruits and vegetables), 2) sociocultural (primary caregiver fruit and vegetable consumption, perception of child liking fruits and vegetables, fruit and vegetable selection self-efficacy, and self-efficacy for healthful child feeding), and 3) economic (primary caregiver education and work status). The proposed conceptual model to explain fruit and vegetable consumption among African American children is shown in Figure 4.1.

Figure 4.1
Conceptual Model of Household Environmental Influences on Eating Behavior of Children



Physical

The household physical environment was measured by two items asking the respondent how often fruits and vegetables were purchased or prepared for meals. The 5-point scale was 'never', 'rarely', 'sometimes', 'often', and 'always'.

Sociocultural

Assessing the household sociocultural environment included the measurement of primary caregiver fruit and vegetable consumption. A 7-point scale was used to measure the frequency of consumption of fruits (1 item) and vegetables (2 items). Response options were 'never or less than once per week', '1 to 3 times per week', '4 to 6 times per week', '1 time per day', '2 times per day', '3 times per day', and '4 or more times per day'. The three fruit and vegetable items were summed to calculate total fruit and vegetable consumption. Fruit and vegetable consumption by children was measured by the same items in the child section as in the adult section. Fruit and vegetable juice and potato consumption were excluded from the analysis.

Primary caregiver perception of children liking fruits and vegetables ('My child likes to eat fruits and vegetables'), fruit and vegetable selection self-efficacy ('I know how to pick out fresh fruits and vegetables'), and self-efficacy for feeding children healthful food as opposed to "junk food" ('I can feed my child fruits, instead of candies, cookies, crackers or chips') were each measured by single items on a 5-point scale from 'strongly disagree' to 'strongly agree'.

Economic

The household economic environment was assessed by questions regarding primary caregiver education and current work status. Responses for highest level of education ranged from '1st-6th grade' to 'bachelor's degree or higher'. Primary caregiver education was collapsed into 3 categories, less than high school, high school graduate/GED, and more than high school prior to analyses. Primary caregiver work status ('Are you employed?') included response categories for 'no', 'part-time', and 'full-time'.

Demographic Characteristics

Primary caregiver weight status was determined based on body mass index (BMI) calculations from self-reported weight and height. BMI cut-offs for weight status categories were determined by widely used definitions.[162] Weight status categories included non-overweight (BMI $\leq$ 24.9 kg/m^2), overweight (BMI=25-29.9 kg/m^2), and obese (BMI $\geq$ 30 kg/m^2). Children's sex was determined by a dichotomous item with 'male' and 'female' response choices. Primary caregiver and child ages were provided by respondents in years and years and months, respectively. Urbanization of household residence was determined based on an item asking for the respondent's 5-digit zip code. Urban and rural categories defined by the U.S. Office of Management and Budget (OMB) were used to determine the urbanization of each respondent's residence.[163]

Data Analysis

Statistical analysis was completed using the SPSS 16.0 software package (SPSS, Chicago, IL). After normality tests were computed for each variable, square root,

logarithmic, or inverse transformations were conducted when appropriate. Descriptive statistics were computed to include the mean, median, and standard deviation of each study variable and demographic characteristics of primary caregivers and children. Pearson correlations were calculated to describe simple relationships between all household environmental variables and fruit and vegetable consumption among children. Household environmental variables significantly associated with fruit and vegetable consumption by children were included in additional analysis. Simultaneous multiple regression analysis was conducted using fruit and vegetable consumption by children as the dependent variable and household environmental factors as the predictor variables.

Results

Descriptive Statistics

The mean age of African American primary caregivers was 29 years (standard deviation (SD)=9) (Table 4.1). The primary caregivers were aged between 17 and 70 years. Twenty percent had less than a high school education and 4% completed a bachelor's degree or higher. Approximately one-half of primary caregivers were not employed. Among those who were employed, 34% worked full-time and 18% were employed part-time. Overweight and obesity was prevalent among the primary caregivers in this study. Obese primary caregivers made up 46% of respondents. One-quarter of the primary caregivers classified as obese had a BMI greater than 40 kg/m^2, a category considered as extreme obesity.[162] Twenty-five percent of primary caregivers were overweight and 29% were not overweight. Only 3 of the 61 non-overweight primary caregivers were considered underweight. Forty-seven percent of the African

Table 4.1
Demographic Characteristics of Primary Caregivers and Children

Primary Caregivers	**Mean**	**SD**
Age	29	9
	Frequency[a]	**%**
Weight status		
Non-overweight	61	28.9
Overweight	53	25.1
Obese	97	46.0
Education		
Less than high school	43	20.3
High School graduate or GED	70	33.0
More than high school	99	46.7
Work status		
Unemployed	110	48.7
Part-time	40	17.7
Full-time	76	33.6
Children		
Gender		
Male	106	46.7
Female	112	51.4
Age		
12-23 months	56	45.5
24-35 months	33	26.8
36-47 months	22	17.9
48-59 months	12	9.8
Household		
Urbanization		
MSA[b] (urban)	186	81.9
non-MSA (rural)	41	18.1

[a] Total frequency of demographic characteristics differs due to missing data.
[b] MSA – metropolitan statistical area.

American children were male and 51% were female. The mean age for the children in this study was 28 months (SD=12). The majority of children (46%) were between 12 and 23 months and the least proportion of children were aged 4 years or older. The vast majority of the primary caregivers and children lived in urban areas instead of rural areas.

Children's Fruit and Vegetable Consumption

In this study, children did not consume enough fruits and vegetables to meet current dietary recommendations for each food group.[82] Only 44% of children met the minimum daily recommendation for consuming fruits and 42% consumed the minimum daily amount for vegetables. Stratifying children by sex, no significant difference was found between the fruit (t=-0.39; p=0.70), vegetable (t=-0.19; p=0.85), or fruit and vegetable (t=-0.40; p=0.69) consumption by males and females.

Household Environmental Factors and Children's Consumption

Eight household environmental factors were selected based on the environment types described in the ANGELO framework, namely physical, sociocultural, and economic.[44] Table 4.2 presents the Pearson correlation coefficients from bivariate analyses between each of the study variables. Six household environmental factors were associated with children's fruit and vegetable consumption. Reported fruit and vegetable consumption by primary caregivers was most strongly related to fruit and vegetable consumption among children, with a positive correlation between caregiver and child consumption (r=0.64; p<0.001). The more primary caregivers prepared fruits

Table 4.2
Bivariate Associations (Pearson Correlation Coefficients) for Study Variables

	Caregiver purchase of F&V[a]	Caregiver preparation of F&V	Caregiver consumption of F&V	Caregiver perception of child liking F&V	Caregiver F&V selection SE[b]	Caregiver healthful child feeding SE	Caregiver education	Caregiver work status
Caregiver purchase of F&V								
Caregiver preparation of F&V	-0.54***							
Caregiver consumption of F&V	0.36***	-0.30***						
Caregiver perception of child liking F&V	0.25***	-0.25***	0.20**					
Caregiver F&V selection SE	0.39***	-0.36***	0.09	0.44***				
Caregiver healthful child feeding SE	0.20**	-0.24***	0.16*	0.61***	0.26***			
Caregiver education	-0.07	-0.10	-0.17*	0.05	-0.01	0.02		
Caregiver work status	-0.17*	0.06	-0.16*	0.03	-0.12	0.20*	0.13	
Child consumption of F&V	0.32***	-0.35***	0.64***	0.26***	0.18**	0.28***	-0.03	-0.11

*p<0.05; **p<0.01; ***p<0.001.
[a] SE – self-efficacy.
[b] F&V – fruits and vegetable.

and vegetables for meals, the less fruits and vegetables children consumed (r=-0.35; p<0.001). Conversely, greater purchase of fruits and vegetables by primary caregivers meant more fruits and vegetables eaten by children as the two factors were positively associated (r=-0.32; p<0.001). The children of primary caregivers who were more confident in their ability to feed their children healthful food (i.e., fruit) instead of processed foods consumed more fruits and vegetables (r=0.28; p<0.001). A similar positive correlation was found between the primary caregiver's perception of whether their child liked fruits and vegetables and the consumption of fruits and vegetables by children (r=0.26; p<0.001). Primary caregiver's self-efficacy for selecting fresh fruits and vegetables was modestly associated with fruit and vegetable consumption by children (r=0.18; p=0.008). The factors within the economic household environment, primary caregivers' education and work status, were not associated with children's fruit and vegetable consumption.

Household Environmental Predictors of Fruit and Vegetable Consumption

Six factors from the physical and sociocultural dimensions of the household environment were significantly associated with fruit and vegetable consumption by children. To test the model describing the influence of household environmental factors on fruit and vegetable consumption by children, a multiple regression analysis was conducted with the six factors significantly correlated to children's fruit and vegetable consumption (Table 4.3). Again, fruit and vegetable consumption by primary caregivers was the strongest predictor of fruit and vegetable consumption by children. The primary

Table 4.3
Simultaneous Multiple Regression Analysis of Predictors of Children's Fruit and Vegetable Consumption

	B	Standard Error of B	β	*t*	*p*-value
Physical					
Caregiver purchase of F&V	0.023	0.158	0.009	0.143	0.89
Caregiver preparation of F&V	-0.427	0.221	-0.120	-1.931	0.05
Sociocultural					
Caregiver consumption of F&V	0.584	0.055	0.579	10.603	<0.001
Caregiver perception of child liking F&V	0.071	0.197	0.025	0.362	0.72
Caregiver F&V selection self-efficacy	0.110	0.169	0.039	0.648	0.52
Caregiver self-efficacy for healthful child feeding	0.367	0.170	0.138	2.156	0.03

$r = 0.69$, $r^2 = 0.48$, adjusted $r^2 = 0.46$, $F(6,210) = 31.70$, $p < 0.001$.

caregiver's self-efficacy for feeding their child healthful food and preparation of fruits and vegetables for meals were also significant predictors of fruit and vegetable consumption by children. Forty-eight percent of the variance in children's fruit and vegetable consumption was accounted for by these household environmental predictors

Discussion

The purpose of this study was to examine household environmental factors influencing fruit and vegetable consumption by low-income African American children. As the research of others has shown, African American children in this study did not

consume enough fruits and vegetables to meet recommendations set by the *Dietary Guidelines for Americans*.[39,82,115,123]

In an explanatory model for dietary behavior among children, three household environmental factors, including primary caregiver fruit and vegetable consumption, self-efficacy for feeding children healthful food, and preparation of fruits and vegetables, significantly predicted fruit and vegetable consumption by children. The explanatory variable in the model that predicted consumption by children the best was primary caregiver consumption of fruits and vegetables. This finding was consistent other research.[120,164,165]

The Social Cognitive Theory (SCT) provides a possible explanation for the relatedness of primary caregiver and child fruit and vegetable consumption. SCT, a theory developed and refined by Albert Bandura, is embedded within an interactional model of causation in which behavior, environmental events, and personal factors interact as interconnected determinants of one another.[166,167] The SCT posits that an individual's social experiences with the surrounding environment influence behavior. The environment provides opportunities to learn how to engage in a behavior through the observation of others, or models, performing the behavior and resulting positive or negative consequences.[167]

The influence of modeling on food preferences and consumption by children are reported in the literature.[168,169] Specifically, previous research has shown the relationship between fruit and vegetable consumption by children and behavioral eating patterns among parents/caregivers. Sylvestre et al[170] reported low-income, urban

mothers with high fruit and vegetable consumption were more likely to have children with high consumption. Campbell et al[171] examined the family food environment and obesity-promoting dietary behaviors in 5- and 6-year-old children. The results included a positive association between vegetable consumption by children and parent modeling of eating.[171] A positive association between parent modeling of fruit and vegetable consumption and children's consumption of fruits, juice, and total fruits, juice, and vegetables was also found among an ethnically diverse group of 4th-6th graders and middle school students.[172,173] The correlation between fruit and vegetable consumption by primary caregivers and children in this study may have resulted from parental modeling. In other words, the children observed primary caregivers eating fruits and vegetables, or no to minimal fruits and vegetables, and subsequent eating behaviors of the children were in reaction to what they learned from the observations.

A positive relationship between the confidence primary caregivers had in feeding children healthful food (i.e., fruit) instead of processed food and children's consumption of fruits and vegetables was found in this study. In addition to observational learning through modeling, expectations (i.e., outcome expectancy), is one of the essential concepts embedded within the SCT.[174] Food preference is considered an outcome expectation or the product of outcome expectations.[175] Food preference involves affinity toward a certain food and/or the choice of one food over another. The preference for certain foods is thought to be a determinant of eating behavior.[176] Since preferences for certain foods are increased with repeated tasting or exposure, children with primary caregivers who are confident in their ability to feed them healthful foods will have

greater exposure and perhaps greater preference.[177,178] Food preferences have a consistent relationship with fruit and vegetable consumption among children.[175,179-181]

The purchase and preparation of fruits and vegetables are important components of the chain food availability for children.[56] A negative correlation was found between the preparation of fruits and vegetables for meals by primary caregivers and fruit and vegetable consumption by children. This finding was surprising. Intuitively, greater preparation of fruits and vegetables at home should result in greater fruit and vegetable consumption for all those living within the home. Accessibility concerns whether foods of interest are available in a form, location, and time to facilitate the consumption of these products.[181] Hearn et al[182] examined relationships between availability/accessibility and fruit and vegetable consumption by children. The results of the study suggested an association between availability and accessibility at home and the consumption of fruits and vegetables by children.[182] Since previous research does not suggest a negative relationship between the preparation of fruits and vegetables at meals (i.e., accessibility) and fruit and vegetable consumption, additional research is required to understand the relationship found in this study.

There are notable limitations to this study. The data for this study were collected using a self-report questionnaire. As a result, social desirability bias may be present. In addition, the variables measured for the primary caregivers and children were completed by the same respondent at the same point in time. It is possible for bias to inflate consistency among the measured variables due to the study design of the original study from where this secondary data were obtained. The primary caregivers reported their

own and children's dietary patterns. Thus, common reporting bias for the caregiver and child's consumption can induce the significant correlation found between the two variables. Additionally, dietary data are prone to measurement error due to daily food consumption variability and the difficulty some respondents have in recalling what they or others consume.

In addition, one or two items were used to measure the household environmental factors. Measures consisting of a single item usually have a low reliability. Although single items are considered usable if the item reflects a homogenous construct, multiple-item measures are still more desirable.[183,184] This is the drawback of examining secondary data from an instrument developed for an alternate purpose. Finally, the cross-sectional design of the original study and using a sample entirely made up of African American WIC participants limits interpretations regarding relationships between the household environmental factors and children's fruit and vegetable consumption and conclusions regarding the generalization of the study findings to all low-income African Americans.

In conclusion, our findings suggest the consumption of fruits and vegetables by African American primary caregivers (sociocultural) is the strongest household environmental predictor of fruit and vegetable consumption by African American children. Other household environmental factors, including primary caregiver self-efficacy for feeding children healthful foods (sociocultural) and preparation of fruits and vegetables for meals (physical), are related to consumption by children to a lesser degree. Additional research is warranted on the inverse relationship between the

preparation of fruits and vegetables for meals (physical) and fruit and vegetable consumption by children. The children in this study did not adhere to the recommended guidelines for fruit and vegetable consumption. Thus, the need continues for obesity interventions targeting an increase in consumption of fruits and vegetables. Incorporating household environmental factors found to have relevance in this study can enhance intervention strategies.

Implications for Practitioners

A current, most critical issue is to develop effective and inexpensive strategies to facilitate long-term adherence to the dietary guidelines demonstrated to prevent obesity and other obesity-related conditions. The household environment is influential in the lives of children and parents are the primary influence of dietary behaviors in early childhood; therefore, targeting the household as a micro-level environmental setting can enhance and reinforce healthy lifestyle behaviors to reduce the risk of obesity. Primary caregivers are continually challenged by obesity-promoting changes in the food and social environment over the past 30 years.[20] Health educators and other public health practitioners should assist parents and caregivers in accessing the tools and resources to empower them to make healthier choices, including increasing the consumption of fruits and vegetables, to promote healthy behaviors in children.

CHAPTER V

CONCLUSION

Summary

The prevalence of obesity and obesity-related health conditions has increased dramatically in the last three decades in the United States. Minority, particularly African American, and low-income populations have faced the greatest obesity burden. The environment, rather than biology, has emerged in recent years as the greatest force behind the epidemic. The research presented in this dissertation study focused on low-income African American primary caregivers and children to gain a greater understanding of eating behaviors and environmental factors. The study included an investigation of diet quality, fruit and vegetable consumption, sociodemographic factors, and household environmental factors.

Chapter II used a systematic method to review current published literature on household environmental factors associated with fruit and vegetable consumption by African American children. Data from ten studies meeting inclusion criteria were extracted and synthesized. The studies presented findings on relationships between children's fruit and vegetable consumption and home availability, participation in food preparation, parental modeling, allowance/pocket money, and kitchen restrictions. A positive association was found in studies between fruit and vegetable consumption by children and home availability and allowance/pocket money. The paucity of studies on

household environmental influences of eating behavior in African American children indicated a need for additional research.

Secondary data collected from a national sample of WIC participants were employed in Chapter III to identify the diet quality of low-income African American women and children and investigate relationships between diet quality and select sociodemographic factors. Sociodemographic factors were selected based on components of Bergner's model of health status.[109] Ordinal logistic regression analysis was used to analyze relationships between low-, mid-, and high-level diet quality and personal and family sociodemographic factors for women and children. For women, age (personal factor), region of residence (family factor), and urbanization (family factor) were associated with diet quality. The quality of diets among children were associated with age (personal factor), urbanization (family factor), and caregiver education (family factor).

A model describing the interconnectedness of household environmental factors and relationships with fruit and vegetable consumption by African American children was proposed in Chapter IV. An ecological model, the ANGELO framework,[44] provided the foundation for the model. A correlation analysis and multiple regression analysis were used to explore relationships within the model. A Texas state-wide survey of WIC participants provided the data used in the analyses. Among the eight household environmental factors in the model, six were associated with fruit and vegetable consumption by children. The strongest predictor of fruit and vegetable consumption in the model was the fruit and vegetable consumption by primary caregivers. To a lesser

degree, relationships were found between fruit and vegetable consumption by children and other household environmental factors, including primary caregiver self-efficacy for healthful child feeding and preparation of fruits and vegetables for meals.

Limitations

The secondary data analyses in this study have several limitations. First, the data used for the analyses were not specifically collected for the purpose of answering the research questions in this study. The study was limited to the data produced by the responses to the measures originally included in the NATFAN and TEXFAN questionnaires. Thus, employing secondary data restricted the ability to include additional factors of potential significance in influencing dietary behavior patterns. This study was also limited to only one or two questionnaire items to measure the majority of the variables of interest. Multiple-item measures are more desirable than those with one or two items since reliability decreases as the number of items decrease.[184] In addition, factor analysis— exploratory and confirmatory— to help determine and verify the number and meaning of constructs underlying the items measured in the questionnaires is lacking. The reporting of results from factor analysis and validity and reliability analyses is needed to completely assess the overall quality of this study.

The original study used a cross-sectional study design. This type of design prohibits conclusions regarding causality. Furthermore, as the data were derived from a cross-sectional design, only a single report of food consumption were captured rather than capturing the same respondents over multiple time periods. A more in-depth,

stronger assessment of diet quality and other diet-related factors may have resulted from recording consumption data over time.

In addition, the sample used to collect the data for the analyses was not random. A convenience sample of WIC participants was used for the Texas and national implementation of the questionnaire. The use of non-random samples has implications for the generalizability of this study to low-income African Americans as the over- or under-representation of certain characteristics of the WIC participants may have occurred in the dataset. Moreover, no conclusions are determinable on whether the women and children in this study have better, worse, or comparable diets to all low-income African American women and children.

Lastly, the analyses used non-triangulated food frequency data for focal variables— primary caregiver and child fruit, vegetable, whole grain, and milk consumption. The data were produced from reports of primary caregivers, both of their own food consumption and those of children. Although parental report of children's diet can provide reliable responses, underestimates of dietary consumption by women can result from social desirability and social approval biases.[142,185,186] Common reporting bias is also a concern and can produce significant correlations between two variables, such as primary caregiver and children's fruit and vegetable consumption. Additionally, dietary data is error prone due to daily variability in food consumption and recollection difficulties respondents have in answering questions about consumption. The use of self-reported dietary behaviors in this study may have led to the misclassification of dietary consumption estimates.

Recommendations

The present study informs research and intervention strategies on obesity and obesity-related behaviors among African American children. In particular, the study advances current knowledge on environmental factors contributing to deleterious dietary behavior patterns in a population with the highest prevalence of obesity and related conditions. Based on the findings of this study, specific recommendations are proposed:

Recommendation 1: Publish more studies in peer-reviewed journals on household environmental factors contributing to fruit and vegetable consumption and other obesity-related behaviors in African American children. The systematic review of published literature undertaken in this study only identified 10 non-intervention studies on fruit and vegetable consumption and household environmental factors in the last 20 years with African American children as the primary focus. Given the extensiveness of national campaigns to increase fruit and vegetable consumption among children and adults, more published research is necessary. Additionally, the breadth of explanatory factors within the household included in research needs greater consideration.

Recommendation 2: Establish health education programs targeting diet quality in African American women and children. Diet quality remains low for healthful food groups, including fruit, vegetables, whole grains, and milk. African American women and children would benefit from comprehensive programs developed to increase overall diet quality taking into account sociodemographic factors such as age, food availability due to region of residence and rurality, and parental education levels.

Recommendation 3: Target caregivers as the primary agent of change for eating behaviors (e.g., fruit and vegetable consumption) in low-income African American children of preschool age. Primary caregiver fruit and vegetable consumption was the strongest predictor of fruit and vegetable consumption by children. Through modeling healthful eating behaviors, improvements to the diets of primary caregivers should lead to a positive change in components of children's diets.

Recommendation 4: *Expand measures of environmental factors for future iterations of the NATFAN and TEXFAN questionnaires.* The original study design included dissemination of the food and nutrition questionnaires prior to and after implementation of changes to the WIC food packages. The data used in this study represented baseline responses from the two questionnaires. The post-implementation (follow-up) questionnaires were distributed nationally this year. The second iteration of the questionnaires remained virtually the same to provide a consistent measure to compare dietary behavior patterns and other factors. However, if future iterations of the questionnaires are disseminated, expanding the number and type of environmental factors would provide further understanding of the dietary patterns of low-income African American women and children and other WIC participants.

Future Research

Prior to establishing multilevel, ecologically-based strategies for improving the diets of African American women and children and reducing the prevalence of obesity, it is necessary to broaden the current understanding of specific environmental factors contributing to obesity-related behaviors. Although this study adds to the understanding

of relationships between environments and eating behaviors, future exploration of this topic will provide researchers, practitioners, and policy-makers with more guidance on the elements necessary to produce effective interventions.

The healthy food indicator was introduced and used for the first time in this study. The index to assess diet quality was well-suited for the secondary data used in the present study, but additional research is needed to establish validity. As discussed in Chapter III, the determination of relationships between the overall healthy food indicator scores and nutrition adequacy or health outcomes (e.g., obesity) will establish validity. Applying the healthy diet indicator to dietary data from other populations (e.g., low-income non-Hispanic whites) is also a future research direction.

As demonstrated in this study, household environmental factors influence the eating behavior of young children. However, other micoenvironmental settings (e.g., school, daycare) play a role in the development of children and act to enhance and reinforce healthy lifestyle messages relayed and learned within the home. After household environmental factors (intra-level factors) are explored to a greater extent, it is important to pursue inter-level factors between microenvironmental settings.

Conclusions

Health behaviors developed in childhood are difficult to modify as children become adults.[24] As a result, it is critical to intervene in early childhood to prevent the development of obesity-related behaviors. Parents and caregivers are continually challenged by obesity-promoting changes to the food and social environment in the last 30 years.[20]

A review of current literature demonstrated the scarcity of studies on environmental factors of fruit and vegetable consumption in children; however, this study makes a contribution to the literature through an examination of healthy eating behaviors and household environmental factors among African American primary caregivers and children. The fruit and vegetable consumption of primary caregivers was the strongest predictor of fruit and vegetable consumption of children among the household environmental factors investigated in this study. Health education strategies to minimize the risk of obesity and obesity-related conditions in early years of life and beyond should consider the dietary behavior patterns of parents and other caregivers.

The diet quality of African American women and children were less than recommended by the *Dietary Guidelines for Americans*.[82] African American women and children would benefit from health education on the importance of consuming fruits, vegetables, whole grains, and low-fat milk in quantities consistent with recommendations. Taking into account personal and family factors as contributors to diet quality, such as age, sex (children), region of residence, urbanization, and caregiver education (children), may enhance strategies to increase the quality of diets in African American women and children.

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APPENDIX A

EXTENDED LITERATURE REVIEW

Obesity Prevalence

Assessment of obesity is most commonly designated by the body mass index (BMI), a measurement of weight-for-height computed by dividing weight (kg) by the square of height (m^2).[1] BMI is used in health education and other social science research as a proxy measure of body fatness. In adults, overweight (BMI = 25.0-29.9) is defined as excess weight for a given height and stature, whereas obesity (BMI $\geq$ 30.0) is described as excess adipose tissue.[1,2] Overweight and obesity in children is defined as a sex- and age-specific body mass index (BMI) of less than or equal to the 85th percentile and greater than or equal to 95th percentile of the CDC growth charts, respectively.[3] BMI is an imperfect measure of adiposity; however, it is considered a useful guide for cross-sectional and longitudinal population-based comparisons and screening tool for weight problems and risk for obesity-related health conditions.[1,4-8]

The rate of overweight and obesity among adults in the United States is 35% and 33.8%, respectively.[9] Women are more likely to be obese than men.[10] Minority women have higher rates of overweight and obesity compared to non-Hispanic white women.[11] African American women have a higher prevalence of obesity than most other minority subgroups, including the highest prevalence of extreme obesity.[12] From 2003-2006, African American women were reportedly 70% more likely to be obese than their non-Hispanic white counterparts.[13] Age-adjusted National Health and Nutrition Examination

Survey (NHANES) data collected on adults from 1988-1994 estimated 37% of the African American female population was obese.[14] The proportion of obese African American women increased to one-half (50%) during the 2007-2008 survey period.[9] The increased prevalence of obesity among African American women seen in the last two decades is a trend also represented among non-Hispanic white and Mexican American subgroups.[9,13]

Despite the role of childhood obesity in raising the risk of obesity in adolescence and adulthood more children are overweight or obese than ever before.[15-21] Obesity among children and adolescents has increased three-fold from 5.5% during the 1976-1980 survey period of NHANES to 16.9% for 2007-2008.[22,23] The prevalence of overweight or obesity among all children and adolescents ages 2 to 19 years is 31.7%. One in every five children 2 to 5 years old (21.2%) is overweight or obese with a BMI at, or above, the 85th percentile for age. Similar to obesity rates among African American women, obesity among African American children is more pronounced in comparison to other race/ethnicity subgroups. Nearly 50% more 2 to 5 year old African American children are overweight or obese than white children (17.4%) in the same age range.[22] Among school-aged children and adolescents, obesity prevalence within the African American race/ethnicity group has increased more than 8 percentage points between the NHANES survey periods 1988-1994 and 2007-2008.[22,24]

Obesity Consequences

The overwhelming prevalence of overweight and obesity has led to substantial human and economic cost due, in part, to the relationship between obesity and the risk of

chronic diseases contributing to morbidity and mortality.[25] An estimated 112,000 excess deaths in the United States each year are attributable to obesity.[26] Specifically, obesity is associated with increased mortality due to cardiovascular disease, diabetes, kidney disease, and obesity-related cancers (e.g., colon, breast, and esophageal cancer).[27] Each of these illnesses is ranked among the ten leading causes of death within the African American population.[28] As body weight increases, the risk of death rises curvilinearly.[29,30] When all causes of death are combined, the obese have a 50 to 100% increased risk of premature death compared to those maintaining a healthy weight.[1]

Significant disparities in mortality exist between black (Hispanic and non-Hispanic) and white (Hispanic and non-Hispanic) populations. In 2006, the age-adjusted death rates among blacks (Hispanic and non-Hispanic) for many diseases often associated with obesity exceeded those for whites, including heart disease by 31% and diabetes by 113%.[13]

Obesity may affect morbidity to a greater extent than mortality.[26] An increased risk of heart disease, stroke, diabetes, hypertension, osteoarthritis, gallbladder disease, disability, and some forms of cancer are correlated with obesity in adults.[1,31-37] Similar to adults, obesity in children leads to many adverse health effects.[38] Childhood obesity is associated with a number of comorbidities, many of which were once considered adult illnesses. Health conditions in childhood, including elevated blood pressure and cholesterol, type 2 diabetes, asthma and sleep-disordered breathing, depression, and menstrual abnormalities are consequences of excess adipose tissue.[38-41]

The public health literature has shown some childhood disease states, including obesity, can result in premature cardiovascular disease.[42] The Bogalusa Heart Study of young people found a strong relationship between coronary atherosclerosis and cardiovascular risk factors such as BMI.[43] Body weight in childhood is also related to the risk of cardiovascular abnormalities in adulthood. In the Muscatine study, Lauer et al[44,45] demonstrated an association between BMI in childhood and elevated adult cholesterol and blood pressure levels.

Diabetes within the African American population has tripled in the last three decades.[46] The incidence of type 2 diabetes, formerly known as adult-onset diabetes, in children and adolescents has also increased dramatically.[47-49] Approximately 1 per 1000 African American children ages 10 and over have type 2 diabetes— a rate more than 5 times greater than non-Hispanic white children (0.19 per 1000).[50] Obesity is an established risk factor for type 2 diabetes.[51,52] In a multi-center, population-based study of children and adolescents 3 to 19 years of age with diabetes, Liu et al[53] reported 80% of participants with type 2 diabetes were obese.

In a recent study of more than 1,200 girls aged 6 to 8 years, Biro et al[54] found an alarming number of girls showed evidence of early onset of sexual development, termed precocious puberty. Early signs of puberty were observed in approximately 23% and 43% of African American 7- and 8-year-old girls, respectively. Precocious puberty is associated with a higher risk of breast cancer and other chronic and psychosocial conditions throughout the lifespan. Obesity is a major factor in early puberty as girls who begin puberty earlier have a higher BMI than those who begin later.[54]

Medical spending among obese adults is $1,429 (42%) greater each year than among adults of normal weight.[55] Annual obesity-related medical spending on adults has increased from approximately $40 billion in 1998 to an estimated $147 billion in 2008.[55] The impact of obesity on medical expenditures is not limited to adults. Each year, direct medical costs associated with obesity during childhood reaches an estimated $3 billion.[56,57] Health spending growth among the obese is a cause for alarm as the healthcare portion of the gross domestic product (GDP) has reached its highest point at 16.2%.[58]

Dietary Recommendations

In addition to regular physical activity, the *Dietary Guidelines for Americans* (*Dietary Guidelines*)[59] recommends the consumption of fewer calories and healthier food choices to promote health and reduce the risk of chronic diseases, including obesity. The *Dietary Guidelines* provide science-based guidance for Americans, over the age of two, on diet and physical activity for the promotion of health and reduction of chronic disease risk.[59] Since 1980, the *Dietary Guidelines* have been updated and published every five years.[60] The current guidelines were released in 2005 and continue to drive federal food and nutrition education policies and advise consumers on how to make healthy dietary and physical activity choices.[61]

The fundamental premise of the *Dietary Guidelines* is based on the consumption of foods as the primary method to meet nutrient needs. Vitamins and minerals and naturally occurring substances found to protect against chronic disease such as carotenoids, flavonoids, isoflavones, and protease inhibitors are directly contained in

foods. Recommended food groups include whole-grains, fat-free or low-fat milk, fruits, and vegetables. Americans tend to consume adequate-to-excessive amounts of protein, thus increased consumption of this food group is not promoted by the *Dietary Guidelines*.[59]

Whole-grain products should be consumed often and at least half the grains should be whole grains rather than refined, or enriched. Whole grains are an important source of fiber. [59] Dietary fiber is important to lowering the risk of cardiovascular disease, stroke, hypertension, obesity, diabetes, and gastrointestinal diseases.[62] In addition, more fiber in diets can improve bowel function (i.e., regularity), blood glucose control, blood pressure, and weight loss ability.[63-66] Despite the benefits, fiber is inadequately consumed by children and adults.[67]

The national guidelines recommend Americans consume 5 to 9 servings of fruits and vegetables each day. The actual quantity specified is dependent on age, gender, and body size.[59,68] The majority of the total amount of fruit consumed daily should be obtained from whole fruits, including fresh, frozen, canned, and dried, rather than fruit juice. A variety of fruits and vegetables should be chosen to consume each day. Dark green (e.g., broccoli, spinach), orange (e.g., carrots, sweet potatoes), legumes (e.g., dry beans, tofu), starchy vegetables (e.g., corn, white potatoes), and other vegetables (e.g., tomatoes, onions) are subgroups recommended for consumption weekly. Fruits and vegetables are excellent sources of complex carbohydrates, dietary fiber, and several vitamins and minerals.[59] Diets rich in fruits and vegetables can reduce the risk of many forms of cancer, including cancers of the pancreas, colon, stomach, esophagus, lung, oral

cavity, breast and cervix.[69,70] Fruits and vegetables also have a protective role in the prevention of many other chronic conditions, including coronary heart disease, stroke, chronic obstructive pulmonary disease, diverticulosis, and hypertension.[71]

Milk should be consumed in the form of fat-free , low-fat, or equivalent products rather than whole milk. The consumption of milk and milk products provide more than 70% of the calcium consumed by Americans and provides many nutrients, including calcium, potassium, magnesium, zinc, iron, riboflavin, vitamin A and D, and folate. [59] The consumption of milk products during childhood and adolescence is important to bone health during critical periods of development and is associated with bone health in adulthood.[59,72] Studies show a positive relationship between milk and milk product consumption and bone mineral content or bone mineral density.[73,74] Regular milk consumption may reduce the risk of diseases such as obesity, diabetes, hypertension, osteoporosis, sarcopenia, and some forms of cancer. Furthermore, milk consumption can reduce blood pressure and promote gut health.[75] Although milk provides a variety of health benefits, many individuals refrain from consuming products in the dairy food group often due to lactose intolerance, allergies, cultural practices, taste, or other reasons.[59]

Foods providing considerable amounts of micronutrients (i.e., vitamins and minerals), that are fairly low in calorie are referred as *nutrient dense foods*. In general, nutrient dense forms of foods are not frequently eaten by Americans. The more low-nutrient density foods are consumed, the greater the difficulty for individuals to consume the recommended amount of nutrients without gaining weight. Children and adolescents

often have low dietary intakes of calcium, potassium, fiber, magnesium, and vitamin E as a result of diets low in whole grains, milk and milk products, fruits, and vegetables.[59]

Diet Quality

Multiple etiologies of obesity exist.[76] Environmental, behavioral, and biological/genetic factors have influence on diet and weight status.[77] The causal components of obesity extend from genes and individual psychobiology through families to communities and society as a whole.[78] Despite its multiple causes, healthy lifestyle habits can lower the risk of developing obesity and related diseases.[38,79,80]

The extent of adherence to dietary standards, or *dietary quality*, can be assessed using index- or score-based methods.[81] Researchers have developed many different indices and scores based upon current key diet-related recommendations.[82] The measures of dietary quality have included components such as servings of food groups, intake of nutrients, and measures of dietary variety, proportionality, or moderation to make up the overall index or score.[83] Studies involving the determinants of dietary quality and relationships between dietary quality and health outcome or disease risk have shown indices are associated with nutrition knowledge, demographic and socioeconomic factors, nutritional biomarkers of micronutrients, body mass index, cardiovascular disease risk and mortality, and breast and colorectal cancer risk.[84-91] Indices with the intent of measuring diet quality often differ in terms of components, values used for standards, and methods for scoring with the intent of looking at diet in the aggregate rather than targeting one food group or nutrient at a time.[81] To illustrate the variety of

index types in public health literature, a select number of the many indices assessing the quality of the American diet are discussed in this appendix.

The U.S. Department of Agriculture developed an index to measure diet quality among children and adults over 2 years of age called the Healthy Eating Index (HEI). The index is used to aid in the evaluation of American diets as compared to current dietary guidance.[92] The first HEI was based on the original USDA Food Guide Pyramid consisting of a balance of fruit, vegetables, grains, milk, and meat servings. The index included 10 components representing food groups, nutrients (total fat, saturated fat, cholesterol, sodium intakes), and dietary variety. Each component contributed up to 10 points and was scored according to the number of servings per day appropriate for a given food energy level (food groups) and general intake guidance (nutrients and variety). Index scores between 0 and 100 were computed from a 24-hour recall and a 2-day food record.[93] The most recent iteration of the HEI was revised to conform to the 2005 *Dietary Guidelines*.[94] The HEI-2005 highlighted the emphasis placed on whole grains, various types of vegetables, specific types of fat, and the new concept of discretionary calories in the 2005 recommendations.[95]

In an attempt to improve upon the HEI, McCullough and colleagues[89] developed a 9-component Alternate Healthy Eating Index (AHEI) focused on food choices and macronutrient sources (e.g., vegetables, fruit, nuts and soy protein, ratio of white to red meat, cereal fiber, trans fat, alcohol) associated with chronic disease risk. The AHEI was calculated using completed food frequency questionnaires and the summed all-component score could range from 2.5 (worst) to 87.5 (best).[89] To rate diet quality in

children and adolescents, the Youth Healthy Eating Index (YHEI) was created.[96] As a modified and simplified form of the HEI, the YHEI accounted for food consumption and dietary behaviors important to growth and development in childhood and adolescence. The data from a food frequency questionnaire was used in the YHEI assessment. The YHEI included 13 components with a possible total score between 0 and 100. The first 7 components (e.g., whole grains, vegetables, sodas and drinks) contributed up to 10 points each and the remaining components (e.g., multivitamin use, eat breakfast, dinner with family) added up to 5 points each. Higher YHEI scores indicated nutrient-dense, healthy diets and good nutrition-promoting behaviors.[96] Overall, the HEI and the YHEI differed as the YHEI mainly focused on health and unhealthy eating behaviors and food choices instead of the calculation of nutrient intakes.[97]

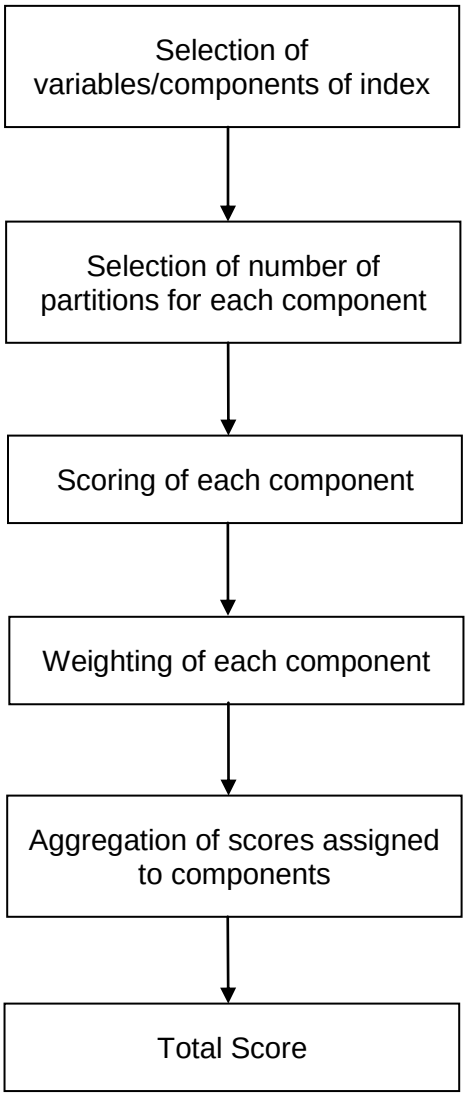
Fogli-Cawley and colleagues[98] created the 2005 Dietary Guidelines for Americans Adherence Index (DGAI) to measure compliance to the key dietary intake recommendations in the *Dietary Guidelines*.[59] The DGAI was a complex, 20-point score consisting of components assessing adherence to energy-specific food intake guidance (11 items) and "healthy choice" nutrient intake recommendations (9 items). The consumption of food groups (e.g., meat and legumes, milk and milk products, grains, fruit and fruit juice, types of vegetables) was determined based on appropriate energy levels for height, weight, age, gender, and physical activity. The healthy choice items included recommendations related to whole grain, fiber, fat and cholesterol, sodium, and alcohol consumption. Dietary data from food frequency questionnaires completed by adult participants in the Framingham Heart Study Offspring Cohort was used to apply

the index. Components were scored from 0 to 1 based on the degree of adherence to each recommendation. If a recommendation was partially adhered to or exceeded the recommendation for energy-dense food items, then a score of 0.5 was assigned. Higher index scores— a maximum score of 20 was possible— indicated greater adherence to current federal guidelines for diet.[98]

Kourlaba et al[99] developed the Elderly Dietary Index (EDI) in an effort to create a simple index suitable to assess diet quality among the elderly. The EDI was developed to include ten components (e.g., meat, vegetables, cereals, dairy, bread) based on the Modified MyPyramid for Older Adults. The scoring system for the EDI included 1 to 4 points for each food component in the index. The scoring system to assign each component score was based on guidelines for older adults and research on food and chronic disease associations. Dietary data from a food frequency questionnaire was used to apply the index to elderly Americans.[82]

To assess the diet quality of African American children and primary caregivers in this dissertation study, a healthy food indicator was developed based, in part, on the EDI created by Kourlaba et al.[82] The EDI was designed for food frequency questions and the data used in this study was derived from survey items of a similar type. The methodology used to develop the healthy food indicator for this study is illustrated in Figure 1. The index to measure diet quality used for the purpose of this study was described in greater detail in Chapter III.

Figure A.1 Methodology for Index Development



Modified from Kourlaba and Panagiotakos.[82]

Dietary Consumption

In general, the eating behaviors of Americans are inconsistent with recommendations to prevent chronic disease.[59] The consumption of grains and whole grains, fruits, vegetables, and dairy products are on average lower than recommended.[100,101] Many children do not have food consumption habits consistent with the federal dietary guidelines.[102] Obtaining a score of 80 out of 100 is considered a healthy diet by the USDA based on their index.[103] Fungwe and colleagues[104] reported that regardless of age the diet of children were less than optimal with total HEI-2005 scores between 54.7 and 59.6 out of 100 possible points. The average child (2 to 17 years) has a total HEI score of 55.9.[104] There are dietary consumption differences between African American and non-Hispanic whites.[105] When HEI scores for African Americans are compared to non-Hispanic whites, African Americans score significantly lower in overall dietary quality and vegetable and milk consumption.[103]

In 2003-2004, individuals in low-income families had significantly lower consumption of total vegetables, dark green and orange vegetables and legumes, and whole grains than families with higher incomes based on HEI component scores.[106] An analysis by Cole and Fox[107] showed Supplemental Nutrition Assistance Program (SNAP), a federal food stamp program, participants in all age groups were less likely to choose whole grains and consume raw vegetables (including salads) and reduced-fat milk than income-eligible nonparticipants and higher income consumers. Participation in food stamps and Women, Infants, and Children (WIC) programs were not found to be positively associated with higher overall diet quality in a study of female food pantry

clients aged 19 to 50 years conducted by Duffy et al,[108] albeit this study was performed prior to the changes to the WIC food packages. However, participation in these food assistance programs was positively associated with subcomponents of the HEI-2005 such as whole fruit and whole grains.[108]

Knol et al[109] studied the overall food patterns of young, low-income children. It was concluded from the study results that children could benefit from the addition of a greater number of foods from the major food groups (e.g., grains, vegetables) into their diets.[109] Of these food groups, the consumption of fruits and vegetables is one of the most important dietary components of health promotion.[110] Specifically, consuming fruits and vegetables regularly is associated with lower caloric intake, fat intake, and BMI.[111,112] Incorporating the recommended amount and variety of fruits and vegetables into a daily diet has a protective effect against certain types of cancer, cardiovascular disease, and stroke and lowers adiposity and risk of obesity.[33,71,113]

Evidence has shown differences in fruit and vegetable consumption due to gender, weight status, and geographic region. In an examination of fruit and vegetable consumption among children and adolescents, Reynolds, et al[114] found a relationship between fruit and vegetable consumption and gender. Seven-day food records completed by children in Georgia showed female respondents consumed more servings of fruits and vegetables (2.43 mean servings/day) than boys (2.25 mean servings/day).[114] Other studies examining the association of gender with the consumption of fruit and vegetables reported similar results.[115]

A study of adults and children over 5 years of age found a negative relationship between fruit consumption and weight status. Specifically, obese children and adults of both genders consumed significantly less fruit than those with a healthy weight status. In children, a consistent relationship was not found between vegetable consumption and weight status. However, adults who consumed more white potatoes had higher BMIs and women who had diets higher in vegetables other than white potatoes had lower BMIs.[113]

Regional differences in fruit and vegetable consumption were explored by Thompson et al[116] through an examination of consumption rates of adults participating in the 5 A Day research trial in seven regions of the United States, including the northeast, southeast, pacific northwest, midwest, south, southwest, and east. Significant overall differences in fruit and vegetable consumption were found among the regions.[116]

Conceptual Framework: Ecological Perspective

The increasing prevalence and severity of childhood obesity have likely manifest due to complex interactions among many factors.[117] The children of obese parents are more likely to become obese than those with normal weight parents.[118,119] This relationship suggests genetic factors play a role in the expression of the obese phenotype.[120] However, heredity is not sufficient to explain current trends in obesity. Both genes and the environment contribute to the lifestyle habits of children, including dietary behavior and physical activity.

Ecology is broadly defined as interrelations between organisms and environments.[121] The ecological perspective in health education focuses on

understanding the nature of people's transactions with their surroundings.[122] The term environment is important to define as it is the domain distinguishing ecological models from other models and theories.[123] The environment includes factors affecting individual behavior that are physically external to, or space located outside of, a person.[122,124]

Bronfenbrenner[125] described three levels of environmental influences interacting with individual variables, the micro-, meso-, and exosystem. The microsystem refers to interpersonal relations experienced in specific settings, including family members, classmates, and work colleagues. A mesosystem consists of interrelations among various settings, including home, school, and work.[125] The exosystem is comprised of settings not involving the individual, but affecting the immediate settings containing the individual, including the parents' work place, mass media, and governmental agencies.[125,126]

Ecological models of health-related behavior posit multiple levels of environmental influence. McLeroy and colleagues[127] described five levels of influence— intrapersonal factors, interpersonal processes and primary groups, institutional factors, community factors, and public policy. The levels of environmental variables are likely to interact and all together help to describe and understand health behaviors and behavior change.[123] Person-environment interactions include varying levels of aggregation such as individuals, families, work and cultural organizations, communities, and populations. The transactions between the environment and individuals are cyclic as individuals influence their behavior settings and the changes to

the settings impact the health behaviors of individuals. [122,128] This reciprocal causation is a key concept of the ecological perspective.[129]

Interpersonal process and primary groups include family, friends, and peers who provide social support and identity. Theories of health behavior incorporating interpersonal factors presuppose individuals exist within and are, in turn, influenced by the environment. Social Cognitive Theory (SCT), as developed and refined by Albert Bandura,[130] involves concepts analogous to elements within ecological models. The theory is embedded within an interactional model of causation in which behavior, environmental events, and cognitive, affective, and other personal factors interact as interconnected determinants of one another.[130,131] Environmental factors are included in the three major categories of reciprocal determinism,[132] one of six essential concepts embedded within SCT.[129] Reciprocal determinism is a complex, bi-directional interaction between personal, behavioral, and environmental influences of behavior.[133] The concept of reciprocal determinism brings health education research beyond the assumption that the person or environment alone determines behavior. The relationships among a person's behavior, the environment where the behavior occurs, and the nature of the person engaging in the behavior can be positive or negative.[134] SCT suggests that behavior is learned through social experiences within the environment.[135] Aspects of people, objects, and circumstances in the life space of children form the environment involved in inhibiting or enhancing the consumption of a healthful diet, such as fruits and vegetables.[136] The environment is an important component in SCT as it provides

models, or examples, for learning behavior.[124] Behavior is learned directly from reinforcement by credible others, and indirectly by observing others.[137]

Researchers have developed several ecological models to explain obesity-related health behavior.[138-140] Swinburn et al[141] proposed an ecological model of obesity dissecting environments described as "obesogenic." Obesogenic environments were defined as "the sum of influences that the surroundings, opportunities, or conditions of life have on promoting obesity in individuals or populations."[141] Obesogenic behaviors (e.g., consumption of large portion sizes, high-fat foods) are often adopted in the presence of an obesogenic environment.[142] The ANGELO Framework (Analysis Grid for Elements Linked to Obesity) categorizes the components of the obesogenic environment into two environmental sizes (microenvironmental settings and macroenvironmental sectors) and four environmental types (physical, economic, political, and sociocultural).

A microenvironmental setting is characterized by its geographical distinctness, small size, and ability to be influenced by individuals. These settings are where groups congregate for specific purposes, often involving food, physical activity or both. For example, homes, neighborhoods, and schools are considered micro-level settings. The macroenvironmental sector is the other environmental size described in the framework. This environment is a group of industries, services, or supporting infrastructure related to obesity through the influence of food consumption and physical activity within microenvironmental settings. Healthcare systems, media, and transportation systems are a few examples of macro-level sectors.

The ANGELO framework divides each setting or sector into environmental types. The physical environment refers to the tangible and intangible factors available (e.g., availability of foods at home), the economic environment are costs associated with diet and physical activity and factors related to income (e.g., socioeconomic status), the political environment consists of laws, regulations, policies, and rules regarding diet and physical activity (e.g., school nutrition policy), and the sociocultural environment includes attitudes, beliefs, and values about diet and physical activity (e.g., parent as role models).[141]

Researchers have used the ANGELO framework in different capacities since its inception. Kremers et al[143] and Simmons et al[144] used the framework as an environmental research framework for obesity prevention. Systematic reviews have used the framework as a classification system for obesogenic environments.[145,146] The framework was also expanded for use as an assessment tool for the environmental determinants of obesity and potential interventions.[141,147] Others found the framework a useful guide for scanning individual behaviors for action.[148]

Based on the importance of the environment in obesity-related behavior, a model was developed for the purpose of this study to explain fruit and vegetable consumption by low-income African American children participating in the Texas WIC program. Using the ANGELO framework, the model organized the correlates of fruit and vegetable consumption within each environment type relevant to the household, including economic, sociocultural, and physical environmental factors. The model was illustrated and discussed in greater detail in Chapter IV.

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APPENDIX B

OPERATIONAL DEFINITIONS

Definitions

The *household* is a micro-level environment composed of all related and unrelated individuals, resources, and circumstances within the same housing unit impacting the health and development of children.[1]

A *family* is considered a group of two or more individuals residing within the same household and/or identifying a common emotional bond and is interrelated by engaging in common social tasks.[2]

The *environment* encompasses a wide variety of factors physically external to a person, or the space outside of the person, affecting a person's behavior.[3-5]

Approaches to understanding health behavior by focusing on understanding the nature of people's transactions with their surroundings is collectively known as the *ecological perspective*.[4]

Overall *diet quality* is based on individual food choices collectively made over time.[6] As a tangible concept, diet quality can be used as a screening and nutrition education tool in community and clinical settings and as a part of research to measure trends in consumption patterns and relationships between diet quality and health outcomes.[7,8]

An *indicator* or *index* is represented as a single number derived from a series of observations and used as a measure or indicator of diet quality.[9]

Food consumption is the intake of food— total or by food type/group.

Variables Studied

Age: This variable was continuous for the caregiver and child. The variable indicated the actual age for the respondent and child.

Education: The categorical variable provided the highest level of education for the respondent.

Food group consumption: The categorical variables for fruit, vegetable, whole grains, and milk consumption indicated the frequency of consumption of these food groups by the respondent and child.

Fruit and vegetable selection self-efficacy: This categorical variable indicated the respondent's confidence in picking out fresh fruits and vegetables.

Perception of child liking F&V: This variable was created based on responses for 3 variables and indicated the caregiver's perception of whether their child likes fruits and vegetables.

Preparation of fruits and vegetables: The categorical variable indicated how often the respondent prepared fruits and vegetables for meals.

Purchase of fruits and vegetables: The categorical variable indicated how often the respondent bought fruits and vegetables.

Region of residence: This categorical variable was created based on the respondent's location when the questionnaire was completed. States, ITOs, and territories were classified into 4 geographical regions: 1) Northeast, 2) Midwest, 3) South, and 4) West.

Self-efficacy for feeding child healthful food: This categorical variable indicated the respondent's confidence in feeding their child fruit instead of junk food.

Sex: This dichotomous variable indicated the sex of the respondent and child (male or female).

Urbanization: This dichotomous variable was created based on reported zip codes to indicate if the respondent resided in a metropolitan statistical area (MSA) or non-MSA.

Weight status: This categorical variable was created based on caregiver self-report of height and weight. The formula (weight in pounds X 703)/(height in inches)^2 was used to calculate the BMI of each respondent. The BMI values were divided into 3 categories: 1) non-overweight, 2) overweight, 3) obese.

Work status: The categorical variable indicated whether the respondent was unemployed, part-time or full-time.

A brief description of the study variables by research question is presented in Table B.1.

Table B.1
Variable List by Research Question

Variable	Type
Q5	
Age	Categorical
Education	Categorical
Food group consumption	Categorical
Region of residence	Categorical
Sex	Dichotomous
Urbanization	Dichotomous
Q3/Q4	
Education	Categorical
Food group consumption	Categorical
Fruit and vegetable selection	Categorical
Perception of child liking F&V	Categorical
Preparation of fruits and vegetables	Categorical
Purchase of fruits and vegetables	Categorical
Self-efficacy for feeding child	Categorical
Weight status	Categorical
Work status	Categorical

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APPENDIX C

ADDITIONAL METHODOLOGY

Table C.1
Healthy Food Indicator Scoring Standards by Component

Age	Score F/V/G	Fruit	Vegetables	Grains	Score Milk	Milk[a]
Children						
Male						
Age						
24-47 months	1	<3 times/wk	<3 times/wk	<3 times/wk	1	No milk/whole milk
	2	4-6 times/wk	4-6 times/wk	4-6 times/wk	2	Low-fat/fat-free
	3	1 time/day	1 time/day	1-2 times/day	1	No milk
	4	≥2 times/day	≥2 times/day	≥3 times/day	2	≥2 cups/day
48-60 months	1	<3 times/wk	<3 times/wk	<3 times/wk	1	No milk/whole milk
	2	4-6 times/wk	4-6 times/wk	4-7 times/wk[b]	2	Low-fat/fat-free
	3	1-2 times/day	1-2 times/day	2-3 times/day	1	No milk
	4	≥3 times/day	≥3 times/day	≥4 times/day	2	≥2 cups/day
Female						
Age						
24-47 months	1	<3 times/wk	<3 times/wk	<3 times/wk	1	No milk/whole milk
	2	4-6 times/wk	4-6 times/wk	4-6 times/wk	2	Low-fat/fat-free
	3	1 time/day	1 time/day	1-2 times/day	1	No milk
	4	≥2 times/day	≥2 times/day	≥3 times/day	2	≥2 cups/day
48-60 months	1	<3 times/wk	<3 times/wk	<3 times/wk	1	No milk/whole milk
	2	4-6 times/wk	4-6 times/wk	4-7 times/wk	2	Low-fat/fat-free
	3	1 time/day	1-2 times/day	2-3 times/day	1	No milk
	4	≥2 times/day	≥3 times/day	≥4 times/day	2	≥2 cups/day

Table C.1 continued

Age	Score F/V/G	Fruit	Vegetables	Grains	Score Milk	Milk
Primary Caregiver						
All Female						
Age						
17 or younger	1	<3 times/wk	<3 times/wk	<3 times/wk	1	No milk/whole milk
	2	4-6 times/wk	4-7 times/wk	4-7 times/wk	2	Low-fat/fat-free
	3	1-2 times/day	2-3 times/day	2-3 times/day	1	No milk
	4	≥3 times/day	≥4 times/day	≥4 times/day	2	≥3 cups/day
18-23 years	1	<3 times/wk	<3 times/wk	<3 times/wk	1	No milk/whole milk
	2	4-7 times/wk	4-7 times/wk	4-7 times/wk	2	Low-fat/fat-free
	3	2-3 times/day	2-3 times/day	2-3 times/day	1	No milk
	4	≥4 times/day	≥4 times/day	≥4 times/day	2	≥3 cups/day
24-29 years	1	<3 times/wk	<3 times/wk	<3 times/wk	1	No milk/whole milk
	2	4-7 times/wk	4-7 times/wk	4-7 times/wk	2	Low-fat/fat-free
	3	2-3 times/day	2-3 times/day	2-3 times/day	1	No milk
	4	≥4 times/day	≥4 times/day	≥4 times/day	2	≥3 cups/day
30-34 years	1	<3 times/wk	<3 times/wk	<3 times/wk	1	No milk/whole milk
	2	4-6 times/wk	4-7 times/wk	4-7 times/wk	2	Low-fat/fat-free
	3	1-2 times/day	2-3 times/day	2-3 times/day	1	No milk
	4	≥3 times/day	≥4 times/day	≥4 times/day	2	≥3 cups/day
35 or older	1	<3 times/wk	<3 times/wk	<3 times/wk	1	No milk/whole milk
	2	4-6 times/wk	4-7 times/wk	4-7 times/wk	2	Low-fat/fat-free
	3	1-2 times/day	2-3 times/day	2-3 times/day	1	No milk
[a]	4	≥3 times/day	≥4 times/day	≥4 times/day	2	≥3 cups/day

Before analysis, the milk component score was weighted so that adherence to guidelines for fluid milk product consumption and milk type received a score of 4 and non-adherence to either subcomponent received a score of 1. Adhering to only one subcomponent received a middle level score of 2.5.

[b] 7 times/wk is the equivalent of endorsing 1 time/day on the questionnaire.

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