PROMOTING VEGETABLE CONSUMPTION AMONG 4- AND 5-YEAR-OLD
STUDENTS: EVALUATION OF A MULTI-COMPONENT NUTRITION
EDUCATION PROGRAM

A dissertation presented by

Kaila R. Wilcox, M.S.

Submitted to
The Department of Counseling and Applied Educational Psychology in partial fulfillment of the requirements for the degree of
Doctor of Philosophy

in the field of
School Psychology

Northeastern University
Boston, Massachusetts
November, 2010
# Table of Contents

Acknowledgements ........................................................................................................ 4

List of Tables ................................................................................................................ 7

List of Figures ................................................................................................................ 8

Abstract .......................................................................................................................... 9

CHAPTER 1: Introduction ............................................................................................. 10
  Consequences of Childhood Obesity ....................................................................... 12
  Contributing Factors to Childhood Obesity ........................................................... 13
  Trajectory of Childhood Dietary Behavior ............................................................... 15
  Rational and Significance ....................................................................................... 16
  Statement of the Problem ....................................................................................... 19
  Research Questions and Hypotheses ..................................................................... 20

CHAPTER 2: Literature Review .................................................................................... 23
  An Epidemic of Ecological Origin ....................................................................... 23
  Stability of Eating Behaviors and Methods for Change ....................................... 24
  Venues for Nutrition Education and Obesity Prevention Efforts ....................... 25
  Evaluation of Nutrition Education and Obesity Prevention Efforts .................... 26
  Summary .............................................................................................................. 68

CHAPTER 3: Methodology .......................................................................................... 73
  Participants and Setting ....................................................................................... 73
  Multi-component Vegetable Promotion Program ................................................. 74
  Classroom Component ....................................................................................... 76
  Lunchroom Component ....................................................................................... 79
  Family Involvement ............................................................................................ 79
  Measures ............................................................................................................. 80
  Weighed Plate Waste ........................................................................................... 80
  Knowledge Change ............................................................................................. 81
  Intervention Acceptability ................................................................................... 82
  Treatment Integrity ............................................................................................... 83
  Materials .............................................................................................................. 84
  Research Design ................................................................................................... 84
  Procedures ........................................................................................................... 85
  Pre-Baseline ......................................................................................................... 85
  Baseline ............................................................................................................... 88
  Intervention ......................................................................................................... 88
  Post-Test ............................................................................................................... 89
  Data Analyses ....................................................................................................... 89
  Behavior Change .................................................................................................. 89
  Knowledge Change ............................................................................................. 90
<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intervention Acceptability</td>
<td>91</td>
</tr>
<tr>
<td>Treatment Integrity</td>
<td>91</td>
</tr>
<tr>
<td>CHAPTER 4: Results</td>
<td>93</td>
</tr>
<tr>
<td>Behavior Change</td>
<td>93</td>
</tr>
<tr>
<td>Knowledge Change</td>
<td>95</td>
</tr>
<tr>
<td>Treatment Integrity</td>
<td>99</td>
</tr>
<tr>
<td>Intervention Acceptability</td>
<td>100</td>
</tr>
<tr>
<td>CHAPTER 5: Discussion</td>
<td>105</td>
</tr>
<tr>
<td>Summary of the Findings</td>
<td>105</td>
</tr>
<tr>
<td>Treatment Integrity</td>
<td>105</td>
</tr>
<tr>
<td>Intervention Acceptability</td>
<td>106</td>
</tr>
<tr>
<td>Behavior Change</td>
<td>107</td>
</tr>
<tr>
<td>Knowledge Change</td>
<td>108</td>
</tr>
<tr>
<td>Study Limitations and Strengths</td>
<td>110</td>
</tr>
<tr>
<td>Directions for Future Research</td>
<td>115</td>
</tr>
<tr>
<td>Conclusions</td>
<td>117</td>
</tr>
<tr>
<td>References</td>
<td>120</td>
</tr>
<tr>
<td>Appendices</td>
<td>141</td>
</tr>
<tr>
<td>Appendix A: Sample Lunch Stickers</td>
<td>141</td>
</tr>
<tr>
<td>Appendix B: Fruits &amp; Veggies More Matters Book</td>
<td>142</td>
</tr>
<tr>
<td>Appendix C: Crave Your Colors Book</td>
<td>152</td>
</tr>
<tr>
<td>Appendix D: Lunchtime Observation Data Collection Sheet</td>
<td>160</td>
</tr>
<tr>
<td>Appendix E: Plate Waste Observation Record Sheet</td>
<td>161</td>
</tr>
<tr>
<td>Appendix F: Acceptability Measure - Children</td>
<td>162</td>
</tr>
<tr>
<td>Appendix G: Acceptability Measure - Teachers</td>
<td>163</td>
</tr>
<tr>
<td>Appendix H: Acceptability Measure - Lunch Monitors</td>
<td>165</td>
</tr>
<tr>
<td>Appendix I: Lunchtime Treatment Integrity Log</td>
<td>166</td>
</tr>
<tr>
<td>Appendix J: Classroom Treatment Integrity Log</td>
<td>167</td>
</tr>
<tr>
<td>Appendix K: Informed Consent – VPP</td>
<td>169</td>
</tr>
<tr>
<td>Appendix L: Informed Consent - Knowledge Measure Development</td>
<td>172</td>
</tr>
<tr>
<td>Appendix M: Plate Waste Data Collection Training Materials</td>
<td>174</td>
</tr>
<tr>
<td>Appendix N: Child Assent</td>
<td>175</td>
</tr>
</tbody>
</table>
Acknowledgements

I would like to acknowledge with gratitude the many supportive individuals who have provided me assistance throughout the dissertation process. I am grateful to my dissertation chair and committee, team of research assistants, family members, and friends who have helped me along the way.

First, I would like to thank my dissertation committee, Drs. Jessica Hoffman, Karin Lifter, and Robert Volpe for their willingness to contribute innovative ideas and an extensive amount of time to this project. Particularly, I would like to recognize and extend my deepest thanks to Jessica for her mentorship and dedication to the development of this nutrition education program and outcome evaluation. Jessica’s amazing enthusiasm for school-based health promotion energized me throughout the research process and kept me motivated when I needed it most. Additionally, her availability and willingness to provide guidance (and deadlines) were sincerely appreciated. Finally, Jessica has been most influential in my professional development. Careful observation of the way in which she collaborates with school and community members throughout the research process was particularly helpful to my development as a psychologist and school-based researcher.

In addition, I would like to acknowledge the administration, staff, and students at the Mather and Condon Schools for their devotion to nutrition education and support for this program. In particular, I wish to thank the K-1 classroom teachers and paraprofessionals for their willingness to implement this intervention. Finally, I would like to express my appreciation for the children who participated in this study.
I wish to acknowledge my team of research assistants for their dedication to this research. Thank you so much Martha Franek, Kayla Lesisko, Katie Flament, Allison Buechner, Alex Hammill, Stephanie Becker, Gillian Hurwitz, Dan Millstein, Jamie Chachere, and Christina Mule! Each of you demonstrated a great willingness to take on any task required, which ranged from administering knowledge assessments, collecting plate waste data, helping many young children with their shoes, to counting peas individually. This research would not have been possible without your support and thoughtful assistance. I am also very grateful for the helpful consultation of Drs. Tak Minami and Andy Field. I could not have completed the statistical analyses without your kind feedback.

Personally, I would like to thank my family for your faith in my ability to complete this project. I would like to thank my mother, Suzanne, for reminding me of your pride in my accomplishments and for helping me to remain motivated with a “this too shall pass” attitude. Additionally, your emphasis on healthy eating at a young age was instrumental in my fondness for vegetables, like frozen peas. I would also like to thank my father, Niles, as well as Ying for your unyielding encouragement and support with problem solving challenges along the way. Each of you helped me to persist through difficulties as they arose.

Last but not least, I am deeply grateful for the good friends who have and continue to support me. I would like to acknowledge Aly Hymes, Amanda Allen, Amanda Borda, Andrea Friedman, Brooke Hamman, Christina Tortolani, Jannon Farkis, Kate Lakowski, Meagan Kessel, and Meg Ahern for encouraging me to balance professional and personal demands and for helping me laugh along the way. I also wish
to thank Benjamin C. Silverman, M.D. for your unrelenting patience when I became overwhelmed, encouragement to persist through the obstacles that arose, and willingness to work alongside me for countless hours at a time. Throughout this process, your motivation inspired me to work harder.

I cannot thank you all enough for your support and encouragement. Your belief in my ability to complete this research has undoubtedly contributed to my success.
### List of Tables

1. Preschool/Head Start-Based Studies................................................................. 71
2. Participant Demographic Information by Group .............................................. 73
3. Components of the Vegetable Promotion Program ........................................... 76
4. Treatment Integrity in the Three Experimental Classrooms.............................. 101
List of Figures

1. Mean Vegetable Intake (g) ........................................................................................................ 94
2. Fruit and Vegetable Naming ................................................................................................. 97
3. Fruit and Vegetable Identification ....................................................................................... 98
4. Mean Number of Fruit and Vegetable Verbalizations During Play ..................................... 99
Abstract

Rates of childhood obesity among children ages 2-5 years have tripled during the past thirty years. Despite these high rates, few nutrition education and obesity prevention programs have been developed to assist children in this age group to make healthy food choices. Because vegetable intake is beneficial for maintaining a healthy weight, it is important to develop and evaluate programs that promote vegetable consumption within the preschool-aged population. Schools have been identified as an important arena for implementing these programs as fruit and vegetables are served daily and children have many opportunities to learn and practice healthy eating behaviors. The purpose of this study was to conduct an outcome evaluation of a multi-component school-based vegetable promotion program with preschool students living in an urban environment. The program included classroom, lunchroom, and family components. Behavior change strategies rooted in social learning theory and behavioral psychology were integrated into the program. This preliminary investigation found that the multi-component intervention was effective in helping young children to consume more vegetables during school lunch. Surprisingly, however, students’ knowledge about fruit and vegetables did not change. The program was acceptable to teachers, lunch monitors, and students. Treatment integrity was variable and methods for increasing treatment integrity are discussed. This study represents a low-cost, easy to implement, school-based intervention that resulted in small changes in young children’s vegetable consumption. It is among a handful of studies to intervene with this age group to promote healthier eating.
Chapter 1

Introduction

In recent decades, the prevalence of overweight and obesity has increased dramatically among children in the United States. Childhood overweight and obesity have reached epidemic proportions such that its prevention has become a public health priority (Institute of Medicine, 2005; U.S. Department of Health and Human Services, 2001). National data indicate that over one-third of children and adolescents (2-19 years old) are classified as “overweight” or “obese” according to Centers for Disease Control and Prevention weight classification guidelines (Odgen et al., 2006). According to present Centers Disease Control and Prevention (2007) guidelines, child and adolescent weight classification is based on age and gender norms and include the following categories: (a) “underweight,” defined as having a BMI-for-age (weight in kilograms divided by the square of height in meters) that is less than the 5th percentile; (b) “healthy weight,” defined as having a BMI-for-age greater than the 5th percentile and less than the 85th percentile; (c) “overweight,” defined as having a BMI-for-age at or above the 85th percentile but less than the 95th percentile; and (d) “obese,” defined as having a BMI at or above the 95th percentile.

The National Health and Nutrition Examination Surveys (NHANES; 1976-1980 & 2003-2004), conducted by the National Center for Health Statistics, Centers for Disease Control and Prevention (NCHS/CDC), provided age-specific data demonstrating significant weight increases among children over time. Since 1980, rates of childhood obesity have grown from 5.0% to 13.9% among children aged 2-5, from 6.5% to 18.8% among children aged 6–11, and from 5.0% to 17.4% among adolescents aged 12–19.
Nationally representative data from the Early Childhood Longitudinal Study, Birth Cohort (ECLS-B) included a larger sample of preschool-age children than the NHANES and revealed higher obesity prevalence rates (18.4%) among 4-year-old children (Anderson & Whitaker, 2009). Excess weight during childhood is a significant public health problem because it has implications for overweight and obese status later in life (Skinner, Bounds, Carruth, Morris, & Ziegler, 2004; Guo, Roche, Chumlea, Gardner, & Siervogel, 1994).

Rising rates of this public health epidemic are prevalent throughout the U.S. population; however, NHANES 2003-2004 data indicate that certain subgroups have been more affected than others. Rates of childhood obesity are greatest among American Indian/Native Alaskan (31.2%), Hispanic (22.0%) and non-Hispanic black (20.8%) preschool-age children, compared to that of non-Hispanic white (15.9%) and Asian (12.8%) 4-year-olds (Anderson & Whitaker, 2009). Additionally, Massachusetts BMI surveillance efforts demonstrate that, in general, rates of childhood overweight and obesity are greatest in urban school districts. The highest rates among girls and boys in grades 1, 4, 7 and 10 were in Lawrence, Fitchburg, Boston, and Springfield (Massachusetts Department of Health, 2010).

Disparities in childhood overweight are likely related to a complex relationship among race, socioeconomic status, and age group (Wang & Zhang, 2006). Higher prevalence rates of childhood obesity were reported among non-Hispanic white adolescents (12-17 years old) of low socioeconomic status (Odgen, Carroll, & Flegal, 2003; Troiano & Flegal, 1998), while another investigation revealed a higher rate of obesity solely among non-Hispanic black girls (6-9 years old) of low socioeconomic
Analyses of NHANES 1988-1994 data reveal inconsistent results with regard to the impact of socioeconomic status. Analyses of nationally representative longitudinal data from another database (National Longitudinal Study of Adolescent Health, NLSY) indicated that socioeconomic status is inversely related to prevalence of childhood obesity (Strauss & Knight, 1999; Strauss & Pollack, 2001).

**Consequences of Obesity.** Obesity can have adverse effects on many facets of children’s lives. Children with excess weight suffer from serious health problems (Centers for Disease Control and Prevention, 2007; Daniels, 2006; Deckelbaum & Williams; 2001; Dietz, 1998a,b; Must & Anderson, 2003; Must & Strauss, 1999; Styne; 2001). Obesity affects cardiovascular health (e.g. hypercholesterolemia, hypertension, dyslipidemia) and the endocrine system (e.g. hyperinsulinism, insulin resistance, impaired glucose tolerance, type 2 diabetes). Other medical issues attributed to obesity include: pulmonary complications (e.g. asthma, sleep apnea, respiratory problems), gastrointestinal disorders, skeletal abnormalities (e.g., Blount Disease, osteoarthritis), stroke, gallbladder disease, osteoarthritis, and some cancers (e.g., endometrial, breast, and colon).

In addition to the health risks associated with obesity, a number of psychiatric, psychosocial, and educational challenges tend to impact obese children, including depression (Erickson, Robinson, Haydel, & Killen, 2000), low self-esteem (Strauss, 2000), and negative self-concept (Davison & Birch, 2001). Furthermore, obese children experience a greater degree of peer relationship problems, including bullying (Janssen, Craig, Boyce, & Picket, 2004), social marginalization (Hill & Silver, 1995; Strauss &
Pollack, 2003) stigma, negative stereotyping, and discrimination (Must & Strauss, 1999; Puhl & Brownell, 2001; Schwartz & Puhl, 2003; Strauss & Pollack, 2003). Children with higher BMIs appear to be absent from school at increased rates and have poorer academic performance (Taras & Potts-Datema, 2005; Yow Daniels, 2008).

**Contributing factors to childhood obesity.** Childhood obesity is a complex public health problem that is ecological in nature. Both biological and environmental factors contribute to the epidemic. The ecological model suggests that individual characteristics are influenced by personal factors that interact with larger social, cultural contexts within which they live (Bronfenbrenner, 1979).

Biological factors influencing childhood overweight include age, gender, and genetic makeup. Although these factors may result in a genetic predisposition to obesity (Farooqi & O’Rahilly, 2000), the genetic composition of the population has not changed as rapidly as the increase in childhood overweight has occurred (Hill & Trowbridge, 1998). This is further support for the ecological conception of childhood overweight, which postulates that biological factors interact with non-biological factors and contribute to the epidemic.

Increased energy intake, decreased physical activity, and increased sedentary behavior pervade the family, school, and community environments in which children live. Excess energy intake is believed to result from children’s tendency to consume large food and beverage portions (Nielsen & Pomkin, 2003), eat meals away from home (Lin, Guthrie, & Frazao, 1999), snack frequently on energy-dense foods, and drink beverages with added sugar (Enns, Mickle, & Goldman, 2002).
Decreased physical activity and increased sedentary behavior likely impact children’s weight status. Several studies report a positive correlation between screen time (i.e., TV, DVD, video games, computer and internet use) and increased prevalence of overweight in children (Crespo, Smit, Troiano, Bartlett, Macera, & Andersen, 2001; Dietz & Gortmaker, 1985; Gortmaker, Must, Sobol, Peterson, Colditz & Dietz, 1996; Robinson, 1999).

Childhood obesity may also be influenced by economic factors. Individuals with limited financial resources are more likely to have energy-dense diets composed of refined grains, added sugars, and added fats. An inverse relationship between energy density (kJ/g) and energy cost ($/MJ) has been found, such that energy-dense foods provide the most dietary energy per dollar (Drewnowski, 2004). The cost of less energy-dense foods, such as fresh produce, has increased rapidly over the past two decades, whereas the price of more energy-dense foods has increased at a much slower rate (Neault, Cook, Morris, & Frank, 2005). As a result, low-income families may not have consistent access to fresh fruit and vegetables. In addition, availability of fresh fruit and vegetables is limited in low-income, minority, urban neighborhoods (Hosler, 2008). Decreased access to and availability of fruit and vegetables likely impact risk for obesity as fruit and vegetable consumption is a beneficial component of healthy weight management and is associated with lower BMI status (Rolls, Ello-Marin, & Tohill, 2004). In a study by Neumark-Sztainer, Story, Resnick and Blum (1996), 40% of participants from low socioeconomic backgrounds consumed an inadequate amount of fruit and vegetables. More recent national surveillance efforts (i.e., Behavioral Risk Factor Surveillance System and Youth Risk Surveillance System) revealed that inadequate fruit
and vegetable consumption pervades all socioeconomic backgrounds. Among a nationally representative sample of adults, only 32.6% consumed fruit two or more times per day and 27.2% ate vegetables three or more times per day (Centers for Disease Control and Prevention, 2007). Among youth, 78.6% of high school students did not eat fruit and vegetables five or more times per day (Centers for Disease Control and Prevention, 2008). These data highlight the need for continued interventions that encourage greater fruit and vegetable consumption.

**Trajectory of childhood dietary behavior.** Children who are not introduced to fruit and vegetables early in life may suffer long lasting consequences. Food preferences are developed at young ages and when produce is not integrated into their diets, children often develop neophobia and later reject these foods (Birch & Fisher, 1998). This tendency is problematic because eating behaviors developed in childhood can perpetuate into adulthood (Kelder, Perry, Klepp, & Lytle, 1994). This developmental trajectory exemplifies the necessity of targeting health promotion programs for young children (Blom-Hoffman, Kelleher, Power, & Leff, 2004).

The implementation of healthy food promotion programs can transform neophobia into acceptance of new food via repeated exposure (Birch & Fisher, 1998) and social influence (Addessi, Galloway, Visalberghi, & Birch, 2005). Addessi et al. (2005) demonstrated that children are more likely to eat new foods if others are eating the same type of food. Fruit and vegetable promotion interventions with young children may assist children in developing a preference for fruit and vegetables early in life, which may help prevent and/or reduce childhood overweight.
Rational and Significance

The school has been identified as an important arena for implementing nutrition education programs (American Dietetic Association, 2006; Centers for Disease Control and Prevention, 2005; Institute of Medicine, 2005; Power & Blom-Hoffman, 2004; Story, Kaphingst, & French, 2006; U.S. Department of Agriculture, 2000). Most children are enrolled in school (Story, Evans, Fabsitz et al., 1999) and consume one-third to one-half of their meals there (Gordon, Fox, Clark et al., 2007). Moreover, students have many opportunities to learn and practice healthy eating behaviors within the educational setting.

Because of these factors, many federal and state agencies have developed policies regarding foods served in schools and recommendations regarding school-based nutrition education curricula. The Centers for Disease Control and Prevention disseminated the Guidelines for School Health Programs to Promote Lifelong Healthy Eating (1996) and the School Health Index (2005), a self-assessment and planning guide for educators, to help improve the dietary behaviors of elementary school students. In 2000 the National Association of State Boards of Education established criteria for policies to promote healthy eating in Fit, Healthy and Ready To Learn, the U.S. Department of Health and Human Services published Healthy People 2010, which included the objective of increasing the proportion of children and adolescents whose intake of meals and snacks at school contribute to good overall dietary quality, and the U.S. Department of Agriculture published Changing the Scene: Improving the School Nutrition Environment. Federal and state agencies have continued to emphasize the importance of the school as being critical in fighting childhood obesity by helping children develop healthy eating behaviors. In 2004, the Centers for Disease Control and Prevention released the Roles of
Schools in Preventing Obesity and, in 2007 the Institute of Medicine published *Nutrition Standards for Foods in Schools*. In 2010 the federal government initiated the *Let’s Move!* campaign, which has further invigorated obesity prevention efforts in schools.

In addition to efforts at the federal level, states are taking action to address the childhood obesity problem through work in the schools. Locally, Massachusetts has developed policies that create a supportive nutrition environment in schools. The Massachusetts Action for Healthy Kids (2008) developed *Massachusetts à la Carte Food and Beverage Standards to Promote a Healthier School Environment*, and Governor Patrick signed the Massachusetts School Nutrition Bill into law on July 30, 2010. Although the standards for the new legislation are in development at this time, the bill will create a commission on school nutrition and childhood obesity for the purpose of studying childhood obesity and identifying effective programs that promote proper nutrition and exercise for children. Other advantages of the bill include increases in reimbursement per meal for the school, which may make it more feasible for schools to provide healthier lunches, and changes to the income requirement by which families qualify for free meals, which will allow a greater number of children to receive free meals at school. Additionally, Massachusetts schools will be mandated to sell fresh fruit and non-fried vegetables.

The recommendations and policies developed by at the national and state-levels have resulted in increased nutrition education and obesity prevention programming. Studies documenting programmatic outcomes have “become a national health priority” (Hill & Trowbridge, 1998; Institute of Medicine, 2005). A growing number of outcome evaluation studies have been conducted and several reviews summarizing nutrition
education, health promotion, obesity prevention, and weight control efforts have been published (Bond, 2010; Contento, 2002; Hesketh & Campbell, 2010; Katz, 2009; Monasta, 2010; Stice, Shaw & Marti, 2006). These reviews indicate that although there has been an increase in outcome evaluation studies of programs attempting to address the obesity epidemic, the body of literature continues to lack rigorously designed programs developed for preschool-age children. In fact, a systematic extensive literature review (Contento, 2002) revealed that only 9% of rigorously designed nutrition education programs are developed specifically for preschool children and the vast majority of programs are aimed at school-age children and adults. Further, a meta-analysis indicated that the average age for children participating in obesity prevention programs is approximately 11 years old (Stice, Shaw, & Marti, 2006). Reviews of programs specifically developed for preschool children (Monasta, 2010) and children 0-5 (Bond, 2010; Hesketh & Campbell, 2010) revealed limited effects on behavior change and prevention of obesity. These authors underscored the need for increased attention to research focused on children 5 years and younger given the small number of outcome evaluations to date and their lack of sustainable positive effect.

Given the current prevalence rates related to overweight and obesity among preschool-aged children (42.4% of boys and 37.8% girls meet classification guidelines for childhood overweight or obesity) and the rise in obesity rates from 5.0% to 13.9% over the past thirty years (Ogden et al., 2006), the American Dietetic Association (2006) recommends further research on prevention programming with preschool-age children. Nutrition education and obesity prevention programs should be adapted to accommodate the specific developmental needs of this age group. Implementation and evaluation of
such efforts will allow for the identification, replication, and dissemination of successful programs appropriate for very young children (Institute of Medicine, 2005).

Statement of the Problem

There has been a dramatic increase in childhood obesity among preschool-aged children, and with significant repercussions. Nutrition education programs can change dietary behaviors. Focusing on young children is important because of the early development and trajectory of eating behaviors. A review of the literature revealed a dearth of nutrition education efforts among children younger than age five while the prevalence of obesity among preschool-age children has increased dramatically over time (Anderson & Whitaker, 2009). The importance of developing and testing nutrition education and obesity prevention programs for younger children, including those promoting vegetable consumption, has been emphasized a priority by Hill and Trowbridge (1998) and the Institute of Medicine (2005). Therefore, it is important to develop and evaluate programs that promote fruit and vegetable consumption within the preschool-aged population as fruit and vegetable intake is beneficial for maintaining a healthy weight (Rolls, Ello-Martin, & Tohill, 2004) and also because very few school-based programs have demonstrated behavior change among young children (Hesketh & Campbell, 2010).

Hoffman, Franko, Thompson, Power and Stallings (2010) developed a multi-component intervention for young children (K-3) that showed evidence of behavior change, resulting in increased fruit and vegetable consumption. The current study extended Hoffman et al.’s (2010) study by examining the effects of this type of multi-component intervention with a younger group of children. As such, the current study
examined the external validity of their intervention by testing it with a separate, younger group of children. Because Hoffman et al. (2010) found that their multi-component intervention resulted in more marked and enduring increases in fruit consumption compared to that of vegetable consumption, the current study extended the literature by focusing on strengthening the reinforcement contingencies for vegetable consumption in an effort to help young children eat more vegetables in the school lunch. This study represents one of the first vegetable promotion efforts that both developed and evaluated a vegetable promotion program designed specifically for preschool-age children. Additionally, this multi-component intervention was among the first implemented within the existing infrastructure and of the preschool. It was also delivered exclusively by school employees rather than specially trained interventionists, which is optimal for institutionalization. Finally, to address the developmental needs of this age group, this study used play as innovative measure of nutrition knowledge, as play is conceptualized as children’s work (Piaget, 1963) and because play behavior is reflective of early cognitive development (Lifter & Bloom, 1998).

**Research Questions and Hypotheses**

This investigation sought to examine the effects of a multi-component nutrition intervention (independent variable) on students’ eating behavior and nutrition knowledge (dependant variables). A second aim of this investigation was to develop a psychometrically sound nutrition knowledge assessment for preschool-age children. The following research questions were posed.

Research Question #1: Is the multi-component nutrition intervention effective in increasing preschool students’ vegetable consumption? Hypothesis #1: It was
hypothesized that students participating in the multi-component nutrition intervention would consume more vegetables during school lunch relative to their baseline and to students in a comparison group.

Research Question #2: Is the multi-component nutrition intervention effective in increasing preschool students’ knowledge of fruit and vegetables? Hypothesis #2a: It was hypothesized that students participating in the multi-component nutrition intervention would name more fruit and vegetables at post-test relative to pre-test and to students in a comparison group. Hypothesis #2b: It was hypothesized that students participating in the multi-component nutrition intervention would correctly identify more foods as fruit and vegetables at post-test relative to pre-test and to students in a comparison group. Hypothesis #2c: It was hypothesized that students participating in the multi-component nutrition education program would increase fruit and vegetable verbalizations during play throughout the intervention.

Research Question #3: To what extent are lunch monitors able to implement the lunchtime component of the intervention with integrity? Hypothesis #3: It was hypothesized that lunch monitors would implement the lunchtime component of the intervention (i.e., provide stickers contingent on one bite of a vegetable) on at least 80% of days observed over a 4-week period.

Research Question #4: To what extent are teachers able to implement the classroom component of the intervention with integrity? Hypothesis #4: It was hypothesized that teachers would implement the classroom component of the intervention (i.e., “Fruit and Vegetable of the Day” announcements, play with fruit and vegetable toys, CD, and DVD) on at least 80% of days over a 4-week period.
Research Question #5: How acceptable is the lunch component of the program to lunch monitors implementing it? Hypothesis #5: It was hypothesized that lunch monitors would report the classroom and lunchroom interventions to be acceptable ($M \geq 5.0$ on a 6-point rating scale) based on prior research (Blom-Hoffman, 2008).

Research Question #6: How acceptable is the classroom component of the program to teachers implementing it? Hypothesis #6: It was hypothesized that lunch monitors would report the classroom and lunchroom interventions to be acceptable ($M \geq 5.0$ on a 6-point rating scale) based on prior research (Blom-Hoffman, 2008).

Research Question #7: How acceptable is the program to students? Hypothesis #7: It was hypothesized that students would report the program to be acceptable ($M \geq 3.5$ on a 4-point rating scale) based on prior research (Blom-Hoffman, 2008).

Research Question #8: How acceptable is the family component to caregivers? Hypothesis #8: It was hypothesized that caregivers would report the family component to be acceptable ($M \geq 2.5$ on a 3-point rating scale) based on prior research (Blom-Hoffman, Wilcox, Dunn, Leff, & Power, 2008).
Chapter 2

Literature Review

An epidemic of ecological origin. Dramatic increases in childhood overweight and obesity rates have caused growing concern among medical and mental health professionals. Childhood obesity rates have nearly tripled since 1980 (Odgen, Carroll & Flegal, 2003), thereby constituting a national crisis of epidemic proportion (Institute of Medicine, 2005; U.S. Department of Health and Human Services, 2001). Reduction of childhood overweight and obesity before 2010 is a national health objective such that the percentage of children with BMI status at or above the 95th percentile does not exceed 5% (U.S. Department of Health and Human Services, 2000).

The multifaceted and ecological nature of the epidemic has resulted from an interaction among biologic (i.e., genetics; Farooqi, & O’Rahilly, 2000), environmental (Crespo et al., 2001; Dietz & Gortmaker, 1985; Gortmaker et al., 1996; Hill & Trowbridge, 1998), and economic factors (Drewnowski, 2004; Gibson, 1999; Neault, Cook, Morris, & Frank, 2005; Neumark-Sztainer, Story, Resnick, & Blum, 1996). Genetics, increased energy intake, decreased physical activity, and increased sedentary behavior contribute to the increasing number of children with overweight and obese weight statuses. Additionally energy-dense foods consisting of refined grains, added sugars, and added fats are often less costly than more nutritious options (Drewnowski, 2004). Not only do less affluent children tend to have less access and availability to fresh produce, but they are also less likely to have safe access to safe playgrounds and outdoor activities (Cradock, Kawachi, Colditz et al., 2005; Suecoff, Avner, Chou, & Crain, 1999).
Nationally representative BMI data indicate that a complex relationship among race, socioeconomic status, and age exists such that a disproportionate number of less affluent children from minority (i.e., Mexican American, non-Hispanic Black, and Native American) backgrounds constitute the population of overweight and obese children in the U.S. (Winkleby, Robinson, Sundquist, & Kraemer, 1999). As a result, treating and preventing childhood obesity is critical in urban, under-resourced communities given its significant and long-term consequences affecting children’s health (Centers for Disease Control and Prevention, 2007; Daniels, 2006; Deckelbaum & Williams, 2001; Dietz, 1998a; 1998b; Must & Anderson, 2003; Must & Strauss, 1999; Styne; 2001), as well as their psychiatric (Erickson, Robinson, Haydel, & Killen, 2000), psychosocial (Must & Strauss, 1999; Puhl & Brownell, 2001; Schwartz & Puhl, 2003; Strauss & Pollack, 2003), and educational (Yow Daniels, 2008) well-being. Moreover, obesity can negatively impact quality of life of children and adolescents (Schwimmer, Burwinkle, & Varni, 2003); it may even result in premature mortality (Must & Strauss, 1999).

**Stability of eating behaviors and methods for change.** In order to avoid such detrimental outcomes, it is important to focus health promotion efforts on young children as poor eating patterns developed during childhood tend to continue into adulthood (Kelder, Perry, Klepp, & Lytle, 1994). It is hypothesized that this trajectory exists as a result of food preferences that are learned at a very young age (Birch & Fisher, 2006). Children experience neophobia (i.e., fear of new foods), and subsequently reject foods to which they have not been previously exposed. Food preferences; however, are sensitive to modification by repeated experience (Myers & Sclafani, 2006; Wardle, Herrera, Cooke, & Gibson, 2003).
Nutrition education programs are one method of helping to shape healthy eating habits, such as fruit and vegetable acceptance, via exposure to and repeated positive experience with these foods (Birch & Fisher, 1998). An extensive literature review of nutrition education programs implemented between 1980 and 1995 concluded that nutrition education can be a significant approach for improving eating patterns, when behavior change was the predetermined goal and when nutrition education strategies were directed toward that goal (Contento, 1995). Nutrition education efforts aimed at introducing young children to a diet rich in fresh produce and providing repeated opportunities for consumption of these foods were beneficial to childhood obesity prevention efforts, given the association between consumption of fruit and vegetables, foods with low caloric density, and reductions in weight (Rolls, Ello-Marin, & Tohill, 2004).

**Venues for nutrition education and obesity prevention efforts.** Community and mental health centers, hospitals, and schools represent several settings for nutrition education and obesity prevention efforts. The school has been identified as an optimal venue for implementation of nutrition education and childhood obesity prevention programming (American Dietetic Association, 2006; Centers for Disease Control and Prevention, 2005; Institute of Medicine, 2005; Power & Blom-Hoffman, 2004; Story, Kaphingst, & French, 2006; U.S. Department of Agriculture, 2000). Most children attend school, where they consume at least one-third of their meals (Gordon et al., 2007). Implementation of school-based nutrition education programs, emphasizing fruit and vegetable promotion, is one method of efficiently helping large groups of children to adopt healthier eating behaviors via repeated exposure to and practice eating nutritious
foods. For that reason, the American Dietetic Association (2006) recommends an ecological approach to treatment and prevention of childhood obesity, including the combination of family-based and school-based multi-component programs that include: (a) nutrition education; (b) behavioral components; (c) parent training/education; and (d) physical activity.

**Evaluation of nutrition education and obesity prevention efforts.** The Institute of Medicine (2005) recommends documenting outcomes associated with nutrition education programs. Careful evaluation of program effectiveness is crucial for establishing empirically validated strategies in the area of nutrition education and obesity prevention. This author systematically reviewed the published literature that evaluated nutrition education efforts with young children. To be included in the this review studies needed to be published, implemented in school or Head Start settings, include children in preschool through second grade, and incorporate nutrition education. Published articles were obtained through computer searches using Medline and PsycInfo databases in November 2008 and September 2010. Ancestral searches were conducted on articles located through the computer searches. Key words included: *nutrition education, obesity prevention, healthy weight promotion,* and *nutrition program*. This review yielded 30 evaluations of 18 programs, which are described below. Only four programs were developed specifically for preschool-age children.

**Experience nutrition.** The Nutrition Education and Training (NET) program implemented in Nebraska elementary schools (grades K-6) was called “Experience Nutrition.” This curriculum included 11 instructional packages (i.e., Making Meals at Schools, Fruits, Vegetables, Snacks, Breakfast, Great School Menus, Physical Fitness,
Key Nutrients, Food Habits, Food Advertising, and Food Safety), each with 12-20 hours of instructional time, and involving food service personnel, teachers, and students. This cognitively-based program aimed to positively affect students’ knowledge and attitudes regarding nutrition through classroom lessons, and these were hypothesized to subsequently result in behavior change. Knowledge and attitude changes were conceptualized as proximal programmatic outcomes, while behavior change was regarded as a distal outcome.

St. Pierre, Cook and Straw (1981) conducted an outcome evaluation of the Nebraska NET program to determine the following: (a) the extent to which it was implemented in participating schools; (b) the short-term effects on knowledge, attitude, preferences, and habits; and (c) the long-term consequences of the program. The variables assessed were treatment integrity, nutrition knowledge, food attitudes and preferences, and eating behavior (i.e., plate waste and observations of fruit and vegetable intake). A modified randomization procedure was used to assign 20 elementary schools to the experimental ($n = 1651$) and control ($n = 700$) conditions. A waitlist control group design was employed such that experimental and control groups were administered pre-test measures, the NET program was implemented in schools assigned to the experimental group, experimental and control groups were administered post-test measures, the NET program was partially implemented in both experimental and control groups, and experimental and control groups were administered follow-up measures. Of note, only 6 of 11 instructional packages were implemented at the time of post-test assessment.
Outcome evaluation data indicated that the Nebraska NET program produced moderate effects (St. Pierre et al., 1981). Results revealed that the lessons were implemented with acceptable levels of integrity; 80% of classroom lessons were implemented as they were intended and 60% of school-wide changes were made by food service staff. St. Pierre et al. (1981) reported that the strongest, most positive effect of the program was increasing students’ nutrition knowledge. Children exposed to the program demonstrated significant knowledge gains, which were maintained at follow-up. The program did not significantly affect food attitudes. Food preferences appeared to be positively impacted by the program, particularly preference for vegetables among children in grades 1-3. The effects of the program on food preferences for children in grades 4-6 were not clear. Last, the program did not result in improved food habits according to students’ self-report, nor did it encourage students to consume a greater amount of their school lunch. The program’s only significant effect on eating behavior was evidenced by 4th-6th grade students’ greater willingness to taste unfamiliar food.

The outcome evaluation of the Nebraska NET program and Experience Nutrition curriculum was strong in study design, including modified random assignment, quantification of treatment integrity, and follow-up data. Findings might have been improved if time permitted the entire curriculum to be implemented prior to post-test assessment.

**Nutrition in a changing world.** This 9-week, school-based nutrition education curriculum was implemented in Pennsylvania elementary schools (grades K-6) during 1979-1980. The program, described as being “experimental” and “pupil-centered” (Graves, Shannon, Sims, & Johnson, 1982), emphasized an appreciation for a variety of
foods, the connection between eating behavior and health, and an introduction to
nutrients in particular foods through classroom and lunchroom activities. Additionally,
posters were placed prominently throughout the cafeteria, promoting healthy messages
(i.e., “Put nutrients in yourselves, not in the can!”) and using Marvel™ comics. Children
were provided nutrition-related activities during indoor recess ($M = 2$ activities per week)
and they were able to earn small rewards (i.e., stickers) for successful worksheet
completion and consumption of vegetables during school lunch.

An outcome evaluation was conducted to assess the impact of the Nutrition in a
Changing World curriculum on children’s nutrition knowledge and attitudes (Graves et
al., 1982) and eating behavior (Shannon, Graves, & Hart, 1982). The evaluation used a
pre-test-post-test waitlist control group design, in which three to four classrooms per
grade were selected to participate. Students (grades K-5) who participated in the program
demonstrated significantly more nutrition knowledge compared with students in the
waitlist control group. Graves et al. (1982) suggested that sixth grade students were not
adequately exposed to the program due to teacher-reported lack of time and investment.
The program produced significant changes in attitudes toward vegetables among children
(grades K-5) and in attitudes toward new foods (first grade students). Of note, there was
an inverse relationship between attitude toward learning about nutrition education and
grade, which suggests that younger students may be more receptive to nutrition education
curricula.

The program had mixed effects on children’s eating behavior as assessed by plate
waste measurements. Kindergarten students who participated in the Nutrition in a
Changing World consumed significantly more broccoli and carrot sticks during snack
time than did those in the control group, who had a greater wheat bread and cheese intake. The curriculum appeared to produce significant increases in students’ (grades 1-6) consumption of spinach, tomato, and bread relative to controls. The program also produced significant increases in green bean consumption among students (grade 4-6). Researchers assessed students’ dessert selection (i.e., banana vs. cake) and there were no significant differences found. Parents reported that program may have resulted in children’s increased request for nutrient dense foods (i.e., fruit and vegetables) and decreased request for sweets and candy.

Lessons learned from the outcome evaluations of *Nutrition in a Changing World* can significantly impact future school-based nutrition education literature. Graves et al. (1982) determined that younger students are more enthusiastic and positive about nutrition education. This important finding provides further evidence that nutrition education efforts should be initiated with young children who appear to be more receptive to them. The program had the least impact on older (i.e., 6th grade) students and the reasons behind this were unknown. Moreover, both outcome evaluations (Graves et al., 1982; Shannon, Graves, & Hart, 1982) demonstrated the importance of collecting treatment integrity data and creating enthusiasm (i.e., teacher buy-in) for the program. Both groups of researchers speculated that these variables negatively influenced program implementation in 6th grade classrooms. Finally, these outcome evaluations are limited in that only a brief description of curriculum and activities was provided and neither was explicitly linked to theory.

**Food for thought, all about nutrition and you.** *Food for Thought, All About Nutrition and You* (Dubinsky & Bodner, 1991) was one of the first nutrition education
programs developed for young children, in kindergarten through third grades. The program was funded by grants from the Florida Nutrition Education and Training (NET) Program following needs assessment results, which suggested that a significant number of children were classified as under- or overweight. The program was developed as a primary prevention program for all students, rather than as a targeted intervention program for students affected by weight issues.

During the 1985-1986 school year, the program originated with a pilot study in which 1,344 students in 60 classrooms in 4 elementary schools participated in four weekly, 20-30 minute nutrition education lessons taught by community health nurses. Of the returned caregiver evaluation forms, 80% indicated that their children discussed the program at home and 96% of parents indicated that they wanted the program repeated. Twenty-four percent of parents reported making changes in food shopping and/or food preparation. As a result, the program was revised and implemented by a public health nutritionist in 2 schools (22 classrooms) with 538 students during the 1987-1988 school year. In this second study, the authors reported increases in nutrition knowledge and small changes in eating behavior as a result of the program; however, the study methods were not well described and the findings were not adequately quantified. Of the returned evaluation forms, 87% of caregivers indicated that their children discussed the program at home, 99% wanted the program repeated, and 30% reported making changes with food shopping and/or preparation to include purchasing more nutritious snacks (i.e., fruit, vegetables, and yogurt).

Preliminary evaluation results were incorporated into the development of the program’s final design. In addition, program planning sessions were held to obtain
feedback from school staff (i.e., teachers, principals, and lunch monitors), parents, and food service personnel. The final program included both home-based and school-based components. Parents received letters and pamphlets describing each of the four food groups.

A school-based instruction manual and kit with audiovisual materials were developed to include age-appropriate lessons and nutrition education activities. This nutrition education program was among the first developed for young children, in kindergarten through third grades. Program developers utilized pilot data to refine age-appropriate and creative activities that utilized multiple modes of instruction. The manualized packaging of this program, complete with activity kits, undoubtedly facilitated the implementation of the intervention; however, treatment integrity data were not collected. The researchers were subsequently unable to report the degree to which the program was implemented as it was intended. Nutrition knowledge was the primary outcome variable evaluated; however, conclusions about any changes in knowledge are highly questionable due the uncontrolled study design. Additionally, different questionnaires were employed pre- and post-test, and the psychometric properties of knowledge assessments are not provided. Pre-tests were described as being less difficult than post-test measures, and, as such, students reportedly did better on the pre-test.

Additionally, the researchers indicated that they failed to translate materials into Spanish, which was likely problematic for participants in one school where the population consisted of predominantly Hispanic students. Finally, the study was limited by a low response (20%-29%) rate on parent forms, which limits the study’s external validity.
Food dudes. Multiple outcome evaluations (Horne, Lowe, Fleming, & Downey, 1995; Horne, Tapper, Lowe, Hardman, Jackson, & Woolner, 2004; Lowe, Horne, Tapper, Bowdery, & Egerton, 2004; Tapper, Horne, Lowe, & Fergus, 2003; Woolner, 2000) have been conducted to evaluate the Food Dudes nutrition education program that was implemented in England and Wales. Food Dudes used a combination of peer modeling and rewards to increase children’s fruit and vegetable exposure via snack time, lunch time, and home components. At snack time, students viewed six, 6-minute peer modeling videos featuring battles between heroic “Food Dudes” and “Junk Punks.” Additionally, teachers read aloud Food Dude letters, which encouraged children to eat fruit and vegetables. Teachers provided students with small rewards contingent upon fruit and vegetable consumption. Stickers were distributed when students ate any portion of their fruit or vegetable. Food Dude customized items (e.g., pens, pencils) were awarded when students consumed the entire portion. “Homepacks,” consisting of suggestions for home-based fruit and vegetable promotion, were distributed.

Several outcome evaluation studies indicated that this program has been an effective method of increasing young children’s fruit and vegetable consumption. The intervention resulted in significant increases in fruit and vegetable intake among children aged 5-7 years in the home setting (Horne et al., 1995), children aged 2-4 years in the nursery (Woolner, 2000), and children aged 5-7 years in the classroom, with increases maintained at follow-up 15 months after program cessation (Horne et al., 1998). In each of these studies, a relatively small number of children were included, and program components were implemented by researchers.
In order to facilitate institutionalization of the Food Dudes nutrition education program, Lowe et al. (2004) conducted an outcome evaluation in which school personnel implemented the program with a wide range of children \((N = 402, 4-11 \text{ years old})\) for 16 days. The intervention significantly impacted fruit and vegetable consumption during snack and lunchtime at school, as evidenced by plate waste data. The program also appeared to improve home-based fruit and vegetable consumption on weekdays. Last, preference for both fruit and vegetables was significantly higher following the intervention. These results were promising; however, due to the absence of a control group, it is unclear whether they were attributable to treatment effects or to external, uncontrolled factors.

Given the optimistic preliminary findings, Horne et al. (2004) replicated the program with a larger number of children \((N = 749, 5-11 \text{ years old})\) using a pre-test-post-test control group quasi-experimental design, with 4-month follow-up. Two under-resourced, inner-city schools were included in the study. The Food Dudes program was implemented for 16 days and was followed by a 10-week maintenance phase, during which children charted fruit and vegetable consumption and earned Food Dude prizes based on an interdependent contingency. Snack and lunchtime plate waste data revealed significant increases in fruit and vegetable consumption relative to baseline and controls.

Follow-up data suggested that fruit and vegetable consumption was higher four months after program termination than it was at baseline. Comparisons between post-test and follow-up revealed significant declines in fruit intake for students of all ages and vegetable intake among children aged 7-11 years. Vegetable consumption showed no decline between intervention and follow-up among children 5-7 years old. Notably,
children who ate the least amount of fruit and vegetables at baseline demonstrated the largest increases in consumption during intervention and follow-up. As found in a previous study (Lowe et al., 2004), increases in fruit and vegetable consumption at home occurred solely during weekdays. This suggests that participants may have had difficulty generalizing healthy eating behavior when they were not exposed to the program’s consistent messages and reinforcement.

The Food Dudes program is an important contribution to the nutrition education literature because the outcome evaluation results contradicted concerns about extrinsically rewarding fruit and vegetable consumption subsequently decreasing intrinsic motivation to engage in this behavior (Deci, Koestner, & Ryan, 1999) and also decreasing preference for that particular food (Birch, Birch, Marlin, & Kramer, 1982, Newman & Taylor, 1992). Horne et al. (2004) demonstrated the beneficial impact that modeling and positive reinforcement can have on increasing children’s acceptance of, exposure to, and consumption of fruit and vegetables.

**Cretan health and nutrition education program.** Crete’s first school-based health and nutrition education program was implemented to promote healthy eating behavior and increased physical activity in children, with the long-term goal of reducing risk for cardiovascular disease in adulthood. This 6-year intervention included adaptations to The Know Your Body School Health Promotion program (American Health Foundation, 1995). It was comprised of school and home-based components intended to increase awareness and to promote behavior change among students and their families in a manner that was sensitive to Greek culture.
Manios, Moschandreas, Hatzis and Kafatos (1999) conducted a randomized controlled outcome evaluation of the program that was implemented in first grade classrooms. Twenty-four elementary schools were randomly assigned to the experimental group (n = 4,172) and 16 schools were assigned to the control group (n = 1,510). Classroom and physical education teachers in experimental schools were oriented to the program during four, 3-hour orientation seminars. Posters, audio-taped fairy tale workbooks, and teaching manuals were provided to aid in the health and nutrition education component of the program. Students were supplied with one workbook annually, which included developmentally appropriate information and activities regarding nutrition, physical fitness, dental hygiene, smoking, and accident prevention. In total, classroom teachers provided 13-17 hours of health and nutrition education per academic year. Physical education teachers provided the program’s fitness component during two, 45-minute classes per week (60 classes per year) and 4-6 hours of annual fitness instruction in the classroom. The home component included parent meetings during which caregivers were provided with their child’s medical screening results assessed at baseline and informational booklets consisting of nutritional guidelines and information on physical activity, cholesterol, hypertension, and obesity management. Control group parents did not attend educational meetings and received their children’s medical screening results by mail.

Nutrition and fitness knowledge scores, anthropometric measurements, physical fitness indices, and biochemical examinations were collected at baseline and after the program had been implemented for 3 years. Parents provided demographic information, medical history information for themselves and their child, food frequency data, and the
regularity of their child’s physical activity. Thirty percent of parents were randomly selected to supply 3 days of plate waste data for their child.

Initial results of the 3-year Cretan Health and Nutrition Education Program included data from 716 students and indicated favorable effects of the intervention. In comparison to the control group, students who participated in the program had decreased serum cholesterol and LDL levels. Additionally, they demonstrated increased health knowledge and smaller increases in body mass index following the program. Students who participated in the program displayed a significantly greater increase in physical activity outside of school and higher fitness levels (i.e., Standing Broad Jump and Sit-Ups). The authors assessed total energy, total fat, monounsaturated fat, polyunsaturated fat, saturated fat, transfat, cholesterol, protein, carbohydrates, and fiber; however, there were no significant differences in nutrition intake between groups.

A ten-year follow-up study (Manios, Kafatos, & Kafatos, 2006) revealed significantly higher moderate to vigorous physical activity levels for males exposed to the program at post-test and follow-up. Furthermore, males in the experimental group were 2.3 and 2.1 times more likely to meet recommendations for physical activity at the post-test and follow-up assessment, respectively, than those in the control group. No significant findings were observed for females. These data suggested that the program had a positive impact on boys' physical activity levels, which were maintained over a long period of time. Follow-up data were not collected on other variables.

Crete’s first school-based nutrition education effort was influential in demonstrating that more parents become involved in seminars when their child’s assessment information is provided as incentive to attend. Other researchers in the field
of nutrition education (Crockett et al., 1989) have experienced poor caregiver attendance rates at parent seminars. In addition, a significant amount of attention was given to introducing the program and preparing teachers to implement it. Researchers were cognizant of treatment integrity, reporting that teachers complied with program expectations; however, treatment integrity was not quantified. Unfortunately, the long-term effects of the program on nutrition-related knowledge, BMI, and eating behavior remain unclear as these variables were not evaluated in the follow-up study. As such, the long-term effects of these nutrition education efforts are not known.

**Healthy start.** *Healthy Start* (Williams, Squillace, Bollella et al., 1998) was a 3-year, NIH-funded intervention for preschool children who were enrolled in Head Start centers. This program was unique in that it incorporated both food service modification and nutrition education for both children and their parents in an effort to reduce cardiovascular disease (CVD) risk among young, underprivileged children. Specific aims of the program included reducing blood cholesterol, reducing dietary intake of total and saturated fat in school meals, and increasing nutrition knowledge.

A pre-test, post-test quasi-experimental design that included a control group was utilized to assess the effectiveness of the *Healthy Start* program. Nine Head Start centers were selected to participate in the outcome evaluation; six were randomly assigned to one of two intervention conditions: (a) food service modification and nutrition education (FS/NU), or (b) food service only (FS). Three centers that were not able to modify food service practices served as controls. The food service modification plan was designed to help Head Start centers meet the guidelines for U.S. Department of Agricultural-reimbursable meal plans, while serving a five-day meal/snack regimen that provided no
more than 30% of energy from total fat and no more than 10% of energy from saturated fat. Food service personnel participated in a one-day training session during which menu planning, recipe development, food purchasing, and food preparation were discussed. Head Start cooks helped to develop objectives for his/her center, which were expected to result in increased fruit, vegetables, and grains served and decreased total and saturated fat content in foods purchased and due to modifications in food preparation methods. Monthly center visits were made to assess progress toward objectives.

The *Healthy Start* nutrition education component was intensive, consisting of three, 15-minute nutrition education classes per week for 30 weeks. The curriculum was based on an integration of concepts from Piaget’s (1969) stages of cognitive development, social learning theory (Bandura, 1977), the high/scope theory of active learning (Hohmann & Weikart, 2002), and Tyler’s four elements of curriculum planning (Tyler, 1949). Teachers participated in a training session in which they were introduced to the *Healthy Start* program rationale and lessons. A variety of teaching methods were used including both large and small-group teacher-directed lessons, student-directed exploration centers, games, crafts, songs, and role plays. Children were taught to distinguish between heart healthy foods, Go foods, that are low in fat content and fiber-rich, and foods that are not heart healthy, Slow foods, that are high in fat content and low in fiber. Caregivers were invited to attend an orientation program. The program’s home component included take-home activities, newsletters, and parent meetings. Control centers utilized a supplemental safety curriculum that educated children and caregivers on violence prevention. Children, caregivers, and educators in these centers did not however receive nutrition education. The food services remained unchanged.
Multiple outcome evaluation studies have assessed the effectiveness of this multi-component program (Williams, Strobino, Bollella, & Brotanek, 2004; Williams, Bollella, Strobino et al., 2002; D’Agostino, D’Andrea, Nix, & Williams, 1999; Williams, Spark, Strobino et al., 1998). Dietary (visual plate waste estimates and 24-hr food recalls), anthropometric (height, weight, and skinfold thickness), and physiologic (total cholesterol, HDL cholesterol, and blood pressure) data were collected at baseline and post-test.

Consumption of saturated fat during Head Start meals decreased significantly after one year of the Healthy Start intervention, and further decreased after the second year, compared with an increase in saturated fat consumption in control centers (Williams et al., 2002). Analysis of menus and recipes also revealed a significant decrease in total fat and saturated fat content in intervention preschools compared no significant change in controls (Williams et al., 2002). A greater decrease in total serum cholesterol was found among preschool children in both intervention groups (FS/NU and FS) compared to controls (Williams et al., 1998). In addition to the significant difference in group means, children with elevated cholesterol at baseline were significantly more likely to have a cholesterol level in the normal range (<170 mg/dL) at post-test if they attended a preschool in one of the food service modification groups (Williams et al., 1998). There was a 30% reduction in risk of elevated cholesterol in the latter compared to controls (Williams et al., 1998). Students in both intervention groups obtained higher scores on nutrition knowledge assessments compared with controls and students who received targeted nutrition education demonstrated greatest increases in nutrition knowledge at post-test (D’Agostino, D’Andrea, Nix, & Williams, 1999). The intervention did not
result in changes in BMI (Williams et al., 2004). Healthy Start is an important contribution to the health promotion and nutrition education literature for preschool-age children. The combination of food service modification and nutrition education appears to be one method for simultaneously decreasing cholesterol levels and increasing nutrition-related knowledge among preschool children.

**Integrated nutrition project (INP).** The Integrated Nutrition Project (INP) is a nutrition education program that was developed for early elementary school students (Auld, Romaniello, Heimendinger, Hamidge, & Hambidge, 1999). The INP utilizes a combination of social cognitive theory (Bandura, 1986) and Piaget’s (1969) theory of cognitive development to increase students’ fruit and vegetable consumption during school lunch, knowledge about and attitudes toward fruit and vegetables, and knowledge of the Food Guide Pyramid. This program, first implemented in 1994, originally included 24 lessons taught by special resource teachers (SRT) who were specifically trained and served as models for teachers. Outcome evaluations (Auld, Romaniello, Heimendinger, Hambidge, & Hambidge, 1998) demonstrated that the INP resulted in significant changes in eating behavior among students and high levels of acceptability among classroom teachers. Further, the specialist-led program overcame barriers to teacher-led implementation, such as time pressure, lack of training, and program infidelity.

Given the success of preliminary INP findings, the program was adapted during the 1997-1998 school years to facilitate institutionalization. The program was modified to include 16 weekly lessons taught alternately by the SRT and the classroom teacher and 6 parent-taught lunchroom activities. All lessons included preparation or consumption of
food, while integrating core classroom subjects. Lunchroom activities allowed students to transfer and apply knowledge learned in the classroom. Parent volunteers encouraged students to consume two servings of fruit and vegetables at lunch. This model of program implementation was expected to: (a) result in SRT’s ability to reach a greater number of classrooms; (b) involve classroom teachers to a greater degree, thereby increasing their experience and confidence in teaching nutrition education lessons; and (c) provide a greater likelihood for INP’s continued presence in schools (Auld et al., 1999).

The adapted INP was evaluated using a cross-sectional, quasi-experimental pre-test, post-test design to compare students in treatment and control classrooms from different schools matched on student ethnicity, SES, and lunch style (offer vs. serve). The outcome evaluation included 760 students from 38, 2nd – 4th grade classrooms in two treatment and two control schools. Teachers self-selected to participate in the study.

Visual estimates of plate waste indicated that students who participated in the INP ate significantly more fruit and vegetables during school lunch as compared to students in the control group. Knowledge and attitude survey results demonstrated that students in the nutrition education program knew more about the Food Guide Pyramid and were more likely to recognize which foods could be added to meals to increase fruit and vegetable intake. Further, students exposed to the INP indicated improved self-efficacy toward food preparation and their perceived ability to eat more fruit and vegetables, and they had more positive attitudes toward school lunches. Classroom observations indicated that the program was implemented with integrity and teacher interviews revealed positive attitudes toward the INP. Although positive outcomes were demonstrated with the abbreviated INP, students in the original, 24-lesson program led
fully by SRTs, made greater increases in fruit and vegetable consumption. Auld et al. (1999) attributed these differences to fewer lessons, fewer lessons taught by the SRT, and failure of classroom teachers to consistently reinforce the behavior change messages.

The INP is an important study in the school-based nutrition education literature as researchers attempt to determine how to institutionalize a nutrition education intervention effectively enough to change eating behavior. The effectiveness of the reduced, 16-lesson INP could be better understood with additional outcome evaluations that are randomized-controlled experiments in which teachers are not self-selected.

**Kiel obesity prevention study (KOPS).** KOPS (Muller, Asbeck, Langnase, & Grund, 2001) was a longitudinal study that investigated the effectiveness of an obesity prevention program for children aged 5-7 years in Germany. A pre-test post-test quasi-experimental design with 4- and 8-year follow-up was employed. The school-based intervention was implemented in first grade classes of 2-4 randomly assigned schools per year during the 1996-2001 school years.

KOPS included a non-intensive nutrition education component, consisting of six nutritionist-led education classes over the course of 2 to 3 weeks. The curriculum included the following messages: (a) eat fruit and vegetables every day; (b) reduce consumption of high-fat foods; (c) engage in at least 1-hr of physical activity each day; and (d) decrease television viewing to less than 1-hr each day. Messages were conveyed in nutrition fairy tales, interactive games, and by preparing a healthy breakfast. After each lesson, students were provided with 20 minutes for physical activity on the school yard. Nutrition education and counseling were provided to parents in the home. Children
in control schools were not provided with supplemental nutrition education or additional time for physical activity.

Anthropometric (i.e., height, weight, skinfold thickness, weight class), bioelectric impedance analysis (i.e., fat mass), and food frequency data were obtained from 780 children in 14 intervention schools at baseline, 345 children at 4-year follow-up, and 4217 children in 32 control schools at baseline, 1419 children at 4-year follow-up. Preliminary follow-up data, one year after the program’s conclusion, were positive based on smaller increases in skinfold thickness and percentage of fat mass for children who participated in the program (Muller, Asbeck, Langnase, & Grund, 2001). After 4 years, the KOPS intervention had no effect on mean BMI; however, the incidence of overweight and obesity was significantly lower in children who participated in the program who were from families with high SES (Plachta-Danielzik, Pust, Asbec et al., 2007).

The effectiveness of the KOPS program appears to be limited after 4-year follow-up. Any conclusions drawn for this intervention must be considered in light of several limitations. The theoretical basis for the program is not explicitly stated and the foundation for lesson content remains unclear. Second, this study’s rate of attrition was high; approximately 56% of children in the intervention group and 66% of the control group discontinued the program. Analyses indicated that a higher rate of overweight children and children from families of low SES dropped out of the study. Generalizability of study findings is limited due to the small number of non-White participants (approximately 7%). Sampling issues are a third possible limitation to the KOPS evaluation. There was a significantly higher prevalence of overweight mothers in
Multiple intelligences. Cason (2001) developed and evaluated a nutrition education program for preschoolers based on Gardner’s (1983) theory of multiple intelligences. The program consisted of 12, 40-minute lessons. Each lesson was designed to incorporate activities from three of the intelligence categories: visual-spatial, bodily-kinesthetic, musical, interpersonal, intrapersonal, linguistic, and logical-mathematical. Lessons included stories, cassettes, videotapes, cooking, field trips, games, posters, discussions, computer lessons, tasting parties, songs, puzzles, art projects, computer lessons, role playing, skits, and puppets.

The outcome evaluation included a one-group comparison of pre-test and post-test knowledge and attitudes for a very large number of preschool-age participants (\(N = 6,102\)) who were enrolled in the United States Department of Agriculture Food and Nutrition Services Food Stamp Nutrition Education Program. The knowledge instrument included questions pertaining to the identification of fruit and vegetables and identification of the healthiest snack. The attitude tool consisted of a measure of participants’ willingness to taste foods. Information regarding the frequency of foods consumed and preference for different foods was obtained via parent report.

The outcome evaluation revealed positive effects of the program. Participating children demonstrated significant improvements in fruit and vegetable identification, healthy snack identification, willingness to taste foods, and frequency of fruit, vegetable, meat, and dairy consumption from pre- to post-test. The evaluation indicated that the use of multiple modes of instruction may be an effective approach for educating preschool
children about nutrition; however, this study was significantly limited in a number of ways. The study design is limited in that there was no control group. Additionally, the link between the lessons and Gardner’s theory of multiple intelligences was not explicit. Given the positive nature of preliminary findings, further evaluation employing a more rigorous study design with a control group is necessary to confirm this program’s impact on children’s nutrition-related knowledge and attitudes.

**Hip-hop to health jr.** Fitzgibbon, Stolley, Dyer, VanHorn and KauferChristoffel (2002) conducted this seminal study that included a 5-year randomized controlled intervention for 3- to 5-year-old African American and Latino children who were enrolled in 24 Head Start programs. The 14-week program’s goal was to alter the trajectory toward overweight/obesity among African American and Latino preschool children. Participants included 778 children (53% African American, 47% Latino) and 646 parents (52% African American, 48% Latino). At baseline, 15% of the Black children and 28% of the Latino children were overweight or obese (BMI ≥ 85th percentile) and more than 75% of the parents were either overweight or obese (BMI ≥ 85th percentile).

Hip-Hop to Health Jr. was an intensive program, consisting of three, 45-minute nutrition education classes per week for 14 weeks. The basis for the intervention was social learning and self-determination theories. Goals of each class included emphasizing hands-on and interactive learning, highlighting the importance of healthy eating and physical activity, encouraging the exploration of new foods, and supporting the relationship among nutritious foods, consistent activity, and healthy bodies. The first half of each class focused on nutrition education and the second half concentrated on physical
activity. The nutrition education component was modeled after the traffic light diet whereby nutritious fruit and vegetables were distinguished as nutritious Go and Grow foods or as Slow foods that are high sugar and/or fat content. A parent component of the program included weekly newsletters, homework assignments, and twice weekly aerobics classes.

Height and weight were the primary outcome variables for both children and adults. Secondary variables included nutrient data from 24-hour dietary recalls, food frequency data, nutrition knowledge data, and assessment of physical activity. Both 1- and 2-year follow-up studies (Fitzgibbon et al., 2005) with African American children indicated that Hip-Hop to Health Jr. was effective in reducing increases in BMI in preschool children. The intervention program did not produce changes in total fat intake, dietary fiber intake, fruit and vegetable consumption, exercise frequency and intensity, or amount of daily TV watching. At 1-year follow-up, Hip Hop to Health Jr. seemed to result in reduced saturated fat intake relative to controls; however, this result was not sustained at 2-year follow-up. Notably, parental compliance with the family component was low likely due to its intensity and multiple demands. Also of note, the program did not produce favorable results with Latino children (Fitzgibbon, 2006), which highlights the importance of adapting program components to cultural differences. The use of a single dietary recall and an unvalidated physical activity measure may have reduced the ability to detect differences in dietary behavior and physical activity. Additionally, the sustainability of this groundbreaking study may be limited in that specially trained early childhood educators, rather than classroom teachers, delivered the intervention. The
authors suggest that the enthusiasm for the curriculum and consistency of the lessons may be less replicable if delivered by classroom teachers.

Be smart. Warren, Henry, Lightowler, Bradshaw and Perwaiz (2003) developed, implemented, and evaluated a pilot school- and family-based obesity prevention intervention for children 5-7 years old. Children in first and second grades were recruited from three elementary schools in Oxford, UK and randomly assigned to a control group or one of three intervention groups (i.e., nutrition education, physical activity, or a combination of nutrition education and physical activity). The program was implemented for four school terms, and was held over 8 weeks per term, weekly during term 1 and biweekly during terms 2-4, totaling 20 weeks of the intervention. Social learning theory provided the basis for lessons, which were researcher-led, interactive, and behaviorally-focused. The following five elements were incorporated into program development: (a) raising the value of the desired behavior; (b) providing the opportunity to taste healthy foods and engage in non-competitive physical activity; (c) providing positive reinforcement; (d) developing practical skills and self-confidence with the behavior; and (e) working with parents to overcome barriers to the desired behavior.

Each of the intervention groups is described below. The nutrition group (“Eat Smart”) had a different focus during each of the four terms during which the intervention was carried out. In the first term, students’ perceptions of health were explored through drawings, the concept of healthy foods was introduced, and a variety of foods were taste tested. In the second term, fruit and vegetables were promoted using the “Give Me 5” message and through taste testing sessions and games. In the third term, power foods were promoted through quizzes, flash cards, and craft activities. In the fourth and final
term, tooth-friendly foods were emphasized and previous knowledge was consolidated. The physical activity group (“Play Smart”) promoted activity in daily life. Energy and activity were explored during the first term. Activity on the playground and reduction of television viewing were investigated during the second and third terms, respectively, and recommendations for physical activity were presented during the 4th term. The combined group (“Eat Smart Play Smart”) received nutrition education and physical activity during each term. Students in each group received activity books, which included weekly homework and messages for both parents and children. Parents were also provided with nutrition education information via newsletter. Students in the control group (“Be Smart”) received food- and health-related information that was not nutrition-based (i.e., food traditions, cultural food practices, food processing). Children also learned about the human body. Students received activity books; however, these books did not include messages.

Anthropometric (i.e., height, weight, BMI, skinfold thickness, and circumference), knowledge, physical activity, dietary assessment (i.e., 24-hr recall, food frequency questionnaire), and acceptability (i.e., parent and teacher) data were obtained for 218 students at baseline and 181 students at follow-up. There were no significant differences in BMI. There was an increase in physical activity during midmorning break for all intervention groups, including the Eat Smart group that did not receive targeted physical activity, compared to controls. Children in the Play Smart and Eat Smart Play Smart group demonstrated significant increases in physical activity during lunch. The intervention did not appear to affect physical activity outside of school. In terms of eating
behavior, significant increases in fruit consumption were observed in the Eat Smart and Be Smart groups.

Students completed a content questionnaire that included both nutrition- and physical activity-related questions. Children in the Eat Smart group scored significantly higher than Be Smart and Play Smart groups on nutrition questions and children in Eat Smart Play Smart scored significantly higher than non-study students. All groups scored higher on physical activity questions when compared with non-study children. Children in the Play Smart and Eat Smart Play Smart groups scored significantly higher than other groups who did not receive targeted physical activity. The program was assessed by parents to be acceptable to both parents and children. Teachers provided suggestions for incorporating some aspects of the Be Smart lessons into the general curriculum.

The Be Smart program was among the first nutrition education programs implemented in the UK and developed for young children. The outcome evaluation is limited by the study design. Researchers questioned whether contamination occurred due to the control group’s increase in fruit consumption. Instead of randomizing by participant, the authors suggest alterations in the study design such that randomization would occur by school and schools would be matched. The findings may also be limited by the short duration of the study. Changes in BMI likely require longer intervention. Finally, the use of positive reinforcement remains unclear. The authors fail to note whether reinforcement was contingent upon consumption. Blom-Hoffman et al. (2004) found students who received higher rates of contingent reinforcement consumed a greater amount of vegetables on their lunch trays.
Everyday lots of ways (EDLW). Blom-Hoffman and DuPaul (2003) conducted this exploratory study that assessed the effects of a multi-component nutrition education program (PA Department of Education, 1996) on knowledge and eating behavior of African American elementary school students. The program was implemented in seven classrooms (K – 6th grade) during the 1999-2000 school year and classrooms were selected according to teacher interest. While all students in the experimental classrooms participated in the program, only those students whose parents consented were included in the outcome evaluation ($n = 103$). A six-classroom constructed control group ($n = 70$) was developed at the same school.

The EDLW program had dual purposes: (a) to increase student knowledge of healthy eating behavior and nutrition; and (b) to increase student’s fruit and vegetable consumption during school lunch. The classroom component consisted of 35 developmentally appropriate lessons, which were divided into three themes according to grade level. Kindergarten and first grade students participated in 10 “5-A-Day” lessons that encouraged students to consume at least five servings of fruits and vegetables each day. Second and third grade students engaged in 12 “Pyramid Power” lessons that exposed them to the food pyramid and encouraged them to eat according to food pyramid recommendations. Fourth through sixth grade students participated in 13 “Energy Choices” lessons that educated students on food energy information, such as calories and fats. Students were taught one lesson per week. The program also included a home component to reinforce nutritional messages learned in the classroom. Students were provided with parent letters introducing the EDLW curricula and homework assignments intended for students to complete with their parents.
In addition to the knowledge change strategies, described above, the program included methods for changing students’ eating behavior that were based on social learning theory and that corresponded with recommendations of the Centers for Disease Control and Prevention (1996). Kindergarten and first grade students were provided verbal praise and stickers contingent upon fruit and vegetable consumption during school lunch. Older students set individualized, healthy eating goals (i.e., “I will try to eat breakfast every day this week”) and were encouraged to monitor these goals. Teachers assisted students in monitoring progress and achieving goals by checking goal sheets and reinforcing students for putting forth effort to accomplish their goals.

Knowledge and behavior change were the primary outcome variables evaluated. Changes in student knowledge, using measures developed by the curriculum developers, were assessed at pre-test, post-test and a 1-month follow-up. Behavior change was assessed using plate waste and the Health Behavior Questionnaire (HBQ; Luepker et al, 1996; Perry, Mullis, & Maile, 1985). Visual plate waste estimates were used to assess students’ fruit, vegetable, dairy, carbohydrate, protein and total food consumption during school lunch. Treatment integrity and treatment acceptability were also assessed.

The evaluation used a pre-test/post-test control group quasi-experimental design, with 1-month follow-up. Students who participated in the multi-component nutrition education program demonstrated significantly larger gains in knowledge from pre-test to post-test than did students in control groups. The program did not produce changes in eating behavior as evidenced by plate waste or HBQ results. On average, treatment integrity was high ($M = 90\%$) for the classroom component of the program; however, the degree of integrity was variable according grade. Kindergarten and first grade teachers
implemented the curriculum with high levels of integrity, second and third grade teachers had acceptable levels of treatment integrity, and fourth and fifth grade teachers had difficulty implementing the curriculum with integrity. Treatment integrity for the lunchtime component was not presented. The EDLW curriculum was perceived as acceptable by both students and teachers.

This theory-based multi-component program addressed Centers for Disease Control and Prevention (1996) recommendations for developing nutrition education interventions. A participatory action approach to research was used in that a multidisciplinary team met bimonthly to discuss implementation issues that arose and to adapt the program accordingly. Finally, treatment integrity and acceptability data, which are often overlooked in nutrition education literature, were quantified and their relationship with program outcomes was discussed. These findings must be interpreted with caution due to the limitations of the study’s quasi-experimental design, unknown psychometric properties of the knowledge tests, and implementation difficulties in 4th and 5th grade classrooms. Lastly, lunchtime treatment integrity data were not provided, so the extent to which students were praised and provided stickers contingent upon fruit and vegetable consumption is unclear.

Blom-Hoffman, Kelleher, Power and Leff (2004) conducted a follow-up study with the EDLW curriculum with kindergarten and first grade students attending an urban, under-resourced school. This study focused on changing students’ knowledge about healthy eating and vegetable consumption, in addition to measuring treatment integrity and program acceptability. The program was implemented in six kindergarten and first grade classrooms that were randomly assigned to an experimental or control group.
The program aimed to increase students’ nutrition knowledge and vegetable consumption during school lunch via classroom, home, and lunchtime components. The classroom component consisted of 10 developmentally appropriate lessons from the EDLW curriculum. Students were taught two lessons per week for five weeks, each of which was based on the “5-A-Day” theme that encouraged students to consume at least five servings of fruits and vegetables each day. Researchers co-taught classroom lessons with kindergarten and first grade teachers. Accompanying each of the lessons were newsletters developed with parent input. Newsletters were intended to reinforce nutritional messages learned in the classroom and also to provide ideas to “help bring the lessons home.” Parent involvement was also encouraged through the development of a home-school fruit and vegetable cookbook. During lunchtime, lunch aides in the experimental classrooms asked children to identify the fruit and/or vegetable in their lunch and provided students with verbal praise and stickers, contingent upon fruit and vegetable consumption. Students in waitlist control classrooms did not receive components of the nutrition education program until after the experimental group received the entire program and the post-test was completed.

Prior to the implementation of the program, researchers held meetings with the lunch aides to establish relationships around shared concerns (i.e., students’ eating habits), discuss feasibility of the program, and model implementation of the intervention. Researchers returned to the classrooms to observe assistants’ implementation of the intervention during lunch. Feedback and further modeling were provided.

Knowledge and behavior change were the primary outcome variables evaluated. A 7-item, curriculum-based measure was administered to assess nutritional knowledge at
pre-test, post-test, and follow-up. Two-week test-retest reliability was 0.64, indicating that knowledge was somewhat stable over the 2-week period. Vegetable consumption during school lunch was assessed using visual estimates of plate waste, which were conducted across three lunches during each of the assessment phases (i.e., pre-test, post-test, and follow-up).

The evaluation of this multi-component program used a pre-test-post-test, waitlist control group design, with follow-up, in which three of six classrooms were randomly assigned to the experimental group, and the remaining three were assigned to the waitlist control group. Students who participated in the program demonstrated significantly more nutrition knowledge compared with students in the waitlist control group, and these gains in knowledge were maintained one month following the program’s completion. The program did not produce significant changes in vegetable consumption among students in the experimental group; however, students in the waitlist control group ate significantly more vegetables after they received the program. Treatment integrity assessments were conducted across 28% of classroom lessons and the knowledge-based classroom component was implemented with high levels of integrity. Additionally, treatment integrity checks were conducted across 21% of lunches. Treatment integrity data for the behaviorally-based component of the program were much more variable. Lunch aides in both experimental and waitlist control groups asked students to identify fruit and/or vegetables with high levels of integrity; however, they had difficulty verbally praising students for fruit and/or vegetable consumption. Although lunch monitors consistently provided students with stickers, there were significant differences between the degree to which stickers were contingently provided to students in the waitlist control and
experimental groups. Of note, students who received higher rates of contingent reinforcement (i.e., students in the waitlist control group) consumed a greater amount of vegetables on their lunch trays. Acceptability data indicated that teachers, classroom assistants, and students perceived the nutrition education program to be acceptable. This theory-based, multi-component program makes a number of important contributions to the school-based nutrition education literature. Importantly, it was among the first to utilize lunch monitors as agents of behavior change. This outcome evaluation clearly demonstrates the necessity of collecting treatment integrity data, which revealed the correlation between contingent reinforcement and behavior change. Additionally, researchers utilized a participatory approach in working with school staff regarding the implementation of the program. The program was subsequently assessed as acceptable by teachers, lunch monitors, and students. The variable level of integrity with which behavior change strategies were used at lunchtime is a limitation in this study. Also, the generalizability of the study findings is questionable due to the small number of classrooms (n = 6) participating.

**Cafeteria power plus.** This 2-year multi-component intervention was implemented in Minnesota elementary schools (grades 1-3) with the goal of increasing fruit and vegetable consumption via modifications to the food service environment. Grounded in social cognitive theory and a health behavior planning model, *Cafeteria Power Plus* sought to change key environmental factors by increasing opportunities to each fruit and vegetables in school, providing healthful role models, and instituting social support for children to eat fruit and vegetables during lunch. The intervention included daily activities (i.e., increasing the availability, appeal, and encouragement of fruit and
vegetables in the school lunch) and “special events” (i.e., posters of life-size fruit and vegetable characters, monthly samplings of fruit and vegetables, a competition to eat 3 servings of fruit and vegetables per day at lunch, a theater production, and a culminating event during which students made a meal demonstrating all of the different foods that can be made from grapes. Training sessions and monthly meetings were held for food service staff to share implementation issues. Perry, Bishop, Taylor et al. (2004) conducted an outcome evaluation of the Cafeteria Power Plus intervention. The primary outcome measure was the number of servings of fruit and vegetables students’ consumed during school lunch using visual plate waste estimates. Secondary outcome measures included the number of fruit and vegetables offered in the lunch line and on the snack cart, the appeal of fruit and vegetables served, and verbal encouragement by food service staff. A randomization procedure was used to assign 35 students per grade (1st and 3rd) in 26 elementary schools (N = 1,820) to the experimental and control conditions. Of this sample, baseline observations included 1,668 students and 1,168 students were observed at follow-up.

Outcome evaluation (Perry et al., 2004) results indicated that the Cafeteria Power Plus program produced favorable effects. The program had a significant impact on students’ eating behavior during school lunch. Plate waste data revealed significantly higher intakes of fruit and vegetables (without potatoes and/or juice) and fruit (with and without juice) among students exposed to the program relative to controls. Perry et al. (2004) did not find significant interactions by gender or grade. Verbal encouragement by food service staff and availability of fruit and vegetables in the lunch line/snack cart were
positively impacted by the program. Of note, nearly all fruit and vegetables were assessed to be “appealing” in both intervention and control schools.

Cafeteria Power Plus demonstrated that an intervention focusing on environmental change in the cafeteria, with theoretically sound behavioral strategies, can impact children’s fruit and vegetable consumption. The authors noted that changes in eating behavior appeared to be considerably more potent when they were integrated with whole-school and family components (Perry et al., 1998). The outcome evaluation of the Cafeteria Power Plus program was strong in study design, including random assignment of a large number of schools.

**German nutrition education program.** Research Association Public Health (Wagner, Meusel, & Kirch, 2005) adapted a previously developed and evaluated nutrition education intervention for kindergarten through fourth grade students in Germany. In addition to revising the program to include more developmentally appropriate lessons in the curriculum, the updated program utilized a nutritional expert to integrate Germany’s requirements for nutrition education programs, including a more long-term intervention that offers nutrition education to parents as well as children.

The program included classroom and parent components. In school, students (K-4th grade) participated in one nutrition education lesson per academic term, followed by a 4-hour activity related to the lesson. While Wagner, Meusel and Kirch (2005) did not describe specific lessons and activities, they provided the general themes taught at each grade level (i.e., distinguishing the food groups, eating meals at regular times, consuming fats, oil, and sweets, eating breakfast daily, drinking healthy beverages, information about each of the food groups, fast food). Parents were invited to attend a “parents’ evening.”
The outcome evaluation consisted of a pre-test-post-test comparison group quasi-experimental design with data from children ($N = 616$), parents ($N = 474$), and teachers ($N = 47$). Students were assigned to the experimental or control group, and outcome evaluation data were compared to those of students in a comparison group (single-event intervention, did not include a parent component, not developmentally adapted).

Child, parent, and teacher knowledge questionnaires were developed in German and based on the nutrition education guide *Healthy Eating for Young People in Europe* (Dixey et al., 1999). The guide provided recommendations for nutrition-based knowledge that should be acquired by children at specific ages. Students’ food preferences were assessed by two methods: (a) students were asked to select preferred foods from a photo menu; (b) and they were asked to select foods from a set of offered items to create a family’s meal. Students’ behavior change was assessed during a breakfast buffet. Children could freely choose from a variety of items, including bread (i.e., whole wheat, dark, white), cheese, butter, sausage, vegetables, yogurt, cereal, hazelnut bars, and cookies. Parent questionnaires asked for detailed descriptions of foods served in the home setting and for subjective perceptions of nutrition-related changes as a result of program. Teacher questionnaires inquired about educators’ attitudes toward the program as well as qualitative changes in children’s behavior related to nutrition (i.e., conversations about food and selecting different food items at lunch and during tea break).

Students who participated in the nutrition education program demonstrated significantly larger gains in knowledge from pre-test to post-test than students in the comparison group and the control group. Of note, children in the age-adapted program
demonstrated the ability to assign foods to food groups significantly more successfully than children who did not participate in the revised program. The adapted program did not produce statistically significant changes in food preference and eating behavior as evidenced by attitude questionnaires or the breakfast buffet. Parents of children in the program reported significant changes in their attitudes toward nutrition, whereas comparison and controls did not.

The effort to adapt the Research Association Public Health’s school-based nutrition education program in order to be consistent with Germany’s requirements is commendable for the developmental appropriateness of the curriculum. Results suggesting increased nutrition-related knowledge following the program were promising; however, findings related to food preference and eating behavior should be regarded with caution due to questionable assessment methods of these variables. Of note, psychometric properties of the preference questionnaire were not provided nor were data collection methods for assessing eating behavior during the buffet. Additionally, a more accurate assessment of children’s eating behavior could be obtained using plate waste measurements. Literature suggests that buffets are a strong predictor of fat intake (Befort, Kaur, Nollen et al., 2006) and that people are more likely to engage in behaviors that lead to overeating at buffets (Wansink & Payne, 2008).

**I am moving, I am learning.** Head Start serves nearly one million low-income preschool children from diverse racial and ethnic backgrounds. The prevalence of obesity among Head Start children is unknown; however, researchers estimate that between 15 and 20 percent of these children are obese (Story et al., 2006; Whitaker & Orzol, 2006). To combat the growing problem of childhood obesity, 17 Head Start
centers piloted the *I am Moving, I am Learning* (IM/IL) program enhancement in 2005, which was developed to offer a framework that can be used to integrate obesity prevention into daily activities. The success of the pilot trainings resulted in the implementation of IM/IL in 53 additional Head Start centers in the spring of 2006 and a mandate that all Head Start regions receive IM/IL training. IM/IL obesity prevention goals include: (a) increasing the quantity of time children spend in moderate to vigorous physical activity (MVPA) to meet national guidelines for physical activity; (b) improving the quality of structured movement activities that are facilitated by teachers and other adults; and (c) promoting healthy food choices among children each day. IM/IL was designed so that Head Start staff could flexibly integrate interactive and engaging health promotion activities into center practices. Rather than serving as a prescribed, stand-alone curriculum that must be followed rigidly in all Head Start centers, IM/IL permits Head Start staff to freely select activities from a set of enhancements (e.g., video on DVD, songs on CD, posters, stickers, etc.) that fit the specific center’s unique needs.

A comprehensive outcome evaluation of this ongoing program is being conducted to further assess program implementation and sustainability. Individual Head Start centers are responsible for, but not mandated to, monitor the effects of program components on BMI, MVPA, structured movement, and food intake. Following year 1 of the IM/IL program, Finkelstein, Whitaker, Hill, Fox, Mendenko and Boller (2007) reported preliminary outcome data including the following: (a) acceptability of the IM/IL training event; (b) perceived importance of IM/IL goals; (c) training models used; (d) IM/IL enhancements implemented with children; and (e) staff enthusiasm about IM/IL and program goals.
A training-of-trainers (TOT) model was used to implement this Head Start-based obesity prevention effort. Fifty-three Region III Head Start centers sent as many as 5 representatives to a 2.5-day training, where they participated in interactive workshops and developed strategies for implementing IM/IL at their centers. Participants were expected to train Head Start colleagues on IM/IL material.

An implementation evaluation (Finkelstein et al., 2007) indicated that the training event was well received. Questionnaires were sent to the staff member from each program designated to lead IM/IL implementation. Response rate was high ($N = 50$, 94%). The training event was evaluated very highly (71% of respondents indicated that the overall training was “excellent”). Head Start staff perceptions of nutrition and physical activity as priority issues were significantly higher following the TOT training. Over 60% of programs provided both pre-service and in-service training on IM/IL and programs reported providing an average of 6 hours staff training. Nearly every program attempted to implement IM/IL during the year following the training event ($N = 96$%). Implementation of enhancement activities related to physical activity was more prevalent than those related to nutrition. Ninety-four percent of programs implemented at least one physical activity-related enhancement activity. Common physical activity enhancements included use of equipment or vocabulary for teaching structured movement and body awareness and introduction of new play equipment. Sixty-seven percent of programs implemented nutrition-related enhancements. Modifying foods served, purchasing instructional materials (e.g., CD, DVD, stickers, posters) featuring IM/IL character “Choosy” were common enhancements in IM/IL nutrition activities. All programs, with the exception of one, included a parent component to IM/IL. Knowledge was most
frequently disseminated via flyer, pamphlet, or newsletter (85%). Workshops and parent events were also held (71%), and nutrition and/or physical activity were discussed during parent-teacher conferences. Staff generally reported positive perceptions of implementing IM/IL. Sixty-six percent of programs rated implementation of nutrition IM/IL enhancements as successful, 63% rated physical activity enhancements as successful, and 56% rated structured movement enhancements as successful. Staff reported the single most important reason for success as being enthusiasm (34%) and the training event (32%). Challenges to implementation were noted as not having sufficient time to devote to IM/IL given other Head Start priorities and lacking funds to purchase necessary IM/IL materials.

The IM/IL obesity prevention program is an important contribution to the literature given its consideration for the unique needs of Head Start centers, permitting flexibility in health promotion activities implemented. IM/IL’s use of technology (i.e., DVD and CD) may help to facilitate institutionalization and sustainability of the program, which has implicit links to social learning theory (i.e., symbolic role modeling, use of reinforcement, and active engagement in learning). Preliminary implementation evaluation findings were promising, although they are significantly limited by self-report rather than direct observation and treatment integrity data. A large-scale outcome evaluation that includes all 53 programs will likely be difficult due to the lack of uniformity of IM/IL enhancements implemented across Head Start centers in Region III. Individual centers should monitor the effect of the multiyear program on children’s BMI, MVPA, time engaged in structured activity, and eating behavior during Head Start hours to provide important data on the effectiveness of IM/IL on childhood obesity.
**Shape up somerville: east smart. play hard.** This three-year multi-component intervention was implemented in Somerville, MA elementary schools (grades 1-3) with the goal of altering the before-, during-, and after-school environments to (a) increase availability of fruit, vegetables, whole grains, and low-fat dairy products while discouraging foods high in fat and sugar and (b) increase opportunities for physical activity. A community-based participatory action approach (Minkler, 2005) was utilized to develop the *Shape Up Somerville* program. The researchers collaborated with community members from the Portuguese, Haitian-Creole, Spanish, and English speaking communities to design, implement, and evaluate the intervention. The multi-component intervention was comprehensive and included multiple features in the school, community, and home environments. Before school, the breakfast program provided increased availability of fresh fruits, vegetables, whole grains, and low-fat milk as well as taste tests of various fruit and vegetables. A walk-to-school campaign was initiated to assist children in walking to school safely. During school, staff participated in professional development focused on nutrition and physical activity, the school health office was provided with anthropometric equipment for height/weight data collection, modifications were made to the school food service (e.g., increased availability of fresh fruits, vegetables, whole grains, and low-fat milk, healthier a la carte snacks, monthly taste tests, vegetarian options, limited availability of ice cream, new equipment to enhance food presentation), a classroom curriculum was implemented (e.g., 30-minute nutrition and physical activity lessons once weekly, 10 minutes of daily physical activity (“Cool Moves”), fun and healthy giveaways), recess was enhanced with new play equipment, and a school wellness policy was developed. After school, school staff participated in
professional development focused on nutrition and physical activity, an after-school curriculum was implemented that provided students opportunities for physical activity, cooking lessons, healthy snacks, and farm trips, and a walk from school campaign was initiated. Families were included in the intervention through bi-monthly newsletters, family events, nutrition forums, and an annual children’s health report card. The community was also heavily involved in the intervention. A sample of Shape Up Somerville’s community-based components included resource guides, a monthly column in the local newspaper, a list of approved restaurants serving healthy options, a 5K Family Fitness Fair, media coverage, training events for physicians and clinical staff, and a “Farmer’s Market” initiative. The program also helped the community obtain $1.5 million in funding to continue the program after the study’s completion.

Economos, Hyatt, Goldberg et al. (2007) conducted an outcome evaluation of the Shape Up Somerville: Eat Smart. Play Hard intervention. The primary outcome measure was BMI z-score. A non-randomized controlled trial was used to assess outcomes of 1178 students in grades 1-3 (experimental, n = 631; control, n = 793). Outcome evaluation (Economos et al., 2007) results from Year 1 indicated that the Shape Up Somerville program produced favorable effects. This is one of the few primary prevention studies to show an intervention effect on children’s BMI z-scores. Economos et al. (2007) also found that mothers’ and fathers’ educational level was not a significant predictor of BMI z-score change.

Shape Up Somerville: Eat Smart, Play Hard demonstrated that an intensive intervention focused on education, availability of healthy foods, and opportunity for increased physical activity implemented in multiple contexts (i.e., before, during, and
after school, at home, and in the community), and developed with a community-based participatory action approach can positively impact children’s BMI $z$-scores. This program was comprehensive, with a particularly strong community component that is unprecedented in the school-based obesity prevention literature. The authors suggest that comprehensive strategies involving changes in multiple environments, reinforced by policies that promote healthy living, are important directions for future obesity prevention research. Additionally, collaboration with community stakeholders at each stage (i.e., problem identification, program design, implementation, and evaluation) was a strength. Research (Leff, Costigan, & Power, 2004; Natasi et al., 2000) has shown that collaboration in this way generally increases intervention acceptability, although acceptability data were not reported on in the outcome evaluation. Lastly, *Shape Up Somerville*’s outcome evaluation was strong in study design, including a large number of participants.

**Athletes in service (AIS) fruit and vegetable promotion program.** This multiyear, school-based primary prevention program was implemented in urban elementary schools (grades K-3) to increase opportunities for elementary school children to be physically active and to help students increase their fruit and vegetable consumption. The program included multiple interventionists, including teachers, lunch monitors, school-based coaches, and principals to implement the school components. Fruit and vegetable intervention components included whole school, classroom, lunchroom, and family activities, which were grounded in social learning theory. Program components were developed to: (a) saturate the school environment with health promotion messages; (b) involve as many individuals as possible with time-efficient
duties; (c) program for behavior change with theoretically based strategies (i.e., “Caught Eating Fruit and Vegetables” whereby students received social encouragement contingent on eating these foods); (d) make realistic changes given the context; (e) use attractive, interactive, and fun materials; (f) have a school-based champion to increase program visibility; and (g) have an interactive family component that engaged many caregivers and children.

A comprehensive outcome evaluation of this multiyear program was conducted (Blom-Hoffman, 2008; Blom-Hoffman, et al., 2008; Hoffman et al., 2010) to assess the effects of program components on children’s nutrition knowledge, consumption of fruits and vegetables in the school lunch, availability and accessibility of fruit and vegetables in the home, and children’s weight status. Implementation integrity and acceptability data were also collected.

Four elementary schools were assigned to the experimental (AIS physical activity and fruit and vegetable promotion; \( n = 2 \)) and control (AIS physical activity only; \( n = 2 \)) conditions. The study cohort included kindergarten and first grade students whose parents consented for them to participate in the evaluation (\( N = 297 \)). As measured by weighed plate waste, the program resulted in increased fruit and vegetable consumption among children in the experimental group relative to their baseline and controls after 15 months of the intervention (Hoffman et al., 2010). At the end of Year 1, children exposed to the AIS program ate an additional 18 grams of fruit and an additional 7 grams of vegetables per day. The effects of the program were reduced following Year 2 with children in the experimental group consuming an additional 7 grams of fruit per day and no additional vegetables. Despite the improvements in lunchtime fruit and vegetable
consumption, students did not report increased preferences for these foods. The program was implemented with acceptable levels of integrity and it was viewed as acceptable by both teachers and lunch staff (Blom-Hoffman, 2008; Hoffman et al. 2010). Notably, 100% of lunch aides indicated that they “strongly agreed” that distributing stickers helped children each more fruit and vegetables in the school lunch.

With regard to the family component, Blom-Hoffman et al. (2008) demonstrated that shared book reading was feasible to implement and was a cost effective method of providing families with nutrition information. The use of interactive books was acceptable to parents, children, and teachers. Parents who received the books demonstrated increased knowledge of the primary nutrition message communicated in the program; however, they did not report increased availability and accessibility of fruits and vegetables at home. The authors demonstrated that interactive books have promise as a low cost, time efficient mechanism of conveying knowledge about nutrition to caregivers. The AIS fruit and vegetable promotion program was strong in design, with explicit links to social learning theory and consideration for the constraints in schools that can impede program implementation and institutionalization.

Summary

A total of 30 studies and 18 programs that included children in preschool through 2nd grade were examined in this systematic review of the literature. Programs were most frequently based on social learning theory and included classroom-based nutrition education components. Over half of the programs reviewed included parents in nutrition education efforts. Seven (Nutrition in a Changing World, Food Dudes, Everyday Lots of Ways (2003, 2004), Cafeteria Power Plus, Shape Up Somerville, and AIS Fruit and
Vegetable Promotion Program) of the 18 programs included a lunchroom component. Only two programs (AIS Fruit and Vegetable Promotion Program and Shape Up Somerville) included multiple components as recommended by the ADA (2006). Programs varied greatly in length, ranging from 2 weeks to multiple years.

Programs produced favorable changes in knowledge more frequently than changes in eating behavior, food preference, or BMI, which likely require consistent intervention over a longer period of time. Additionally, nutrition-related behavior change may require contingent reinforcement, which was difficult for school staff to accomplish with integrity. Checking in regularly with school staff to resolve issues with program implementation was one way to combat this difficulty.

The reported effectiveness of nutrition education interventions depends on many factors, including the nature, duration, and power of the interventions and the degree to which the interventions were implemented as designed (Contento, 2002). As such, assessing treatment integrity is critical to the merits of an outcome evaluation. Three of the programs reviewed (Experience Nutrition; Everyday Lots of Ways; AIS Fruit and Vegetable Promotion Program) quantified the extent to which interventions were carried out as intended. Additionally, two programs (Everyday Lots of Ways; AIS Fruit and Vegetable Promotion Program) included formal acceptability assessments. Acceptability of program components should be assessed formally to allow for alterations that will more likely promote institutionalization of nutrition education efforts. Participatory action research appears to be an effective method for developing acceptable interventions.
This systematic review demonstrates the deficit in nutrition education and obesity prevention programming for children between the ages of 2-5 years. While the American Dietetic Association (2006) recommends further research focused on prevention efforts among preschool children as critical to the ongoing battle against the obesity epidemic, only four of the programs reviewed (i.e., Healthy Start; Hip Hop to Health Jr.; Multiple Intelligences; I am Moving, I am Learning) were developed exclusively for this age group (see Table 1 for description of programs developed for children in preschool and Head Start). Although each of these four programs is beneficial to the body of nutrition education and obesity prevention literature, all four programs either did not measure changes in fruit and vegetable consumption or did not utilize measures sensitive enough to detect changes in eating behavior. The current study addressed this important gap in the preschool-based literature by monitoring children’s eating behaviors using highly accurate, objective plate waste methods. Accurately assessing fruit and vegetable intake is an important component to both obesity prevention and intervention efforts because consumption of these foods, which are high in water and low in energy density has been associated with lower energy intake and healthy weight management (Rolls, Ello-Marin, & Tohill, 2004). The current study is based on the AIS program (Blom-Hoffman, 2008; Blom-Hoffman et al., 2008; Hoffman et al., 2010), which was found to be both effective in increasing fruit and vegetable consumption and acceptable to interventionists, students, and families.
### Table 1

**Preschool/Head Start-based studies**

<table>
<thead>
<tr>
<th>Study</th>
<th>Location</th>
<th>Design</th>
<th>Participants</th>
<th>Theoretical basis</th>
<th>Program Components</th>
<th>Duration</th>
<th>Measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Healthy Start (D’Agostino et al., 1999; Williams et al., 2004; Williams et al., 2002)</td>
<td>9 Head Start Centers</td>
<td>Pre-test, post-test quasi-experimental</td>
<td>2.5-5 years old; N = 814; Predominantly low income African American, Latino and Caucasian children</td>
<td>Social learning (Bandura, 1977), stages of cognitive development (Piaget, 1969), high/Scope theory of active learning (Hohmann &amp; Weikart, 2002)</td>
<td>Classroom-based nutrition education, (“Go vs. Slow”), lunchroom-based menu modification &amp; family component including initial orientation to program and take-home activities.</td>
<td>2 years</td>
<td>Visual plate waste est., 24-hr food recalls, anthropometry, cholesterol, blood pressure, knowledge assessment</td>
</tr>
<tr>
<td>Multiple Intelligences (Cason, 2001)</td>
<td>229 preschool centers enrolled in USDA Food Stamp Program</td>
<td>One-group comparison of pre-test and post-test</td>
<td>3-5 years old; N = 6102; Predominantly low income African American and Caucasian children</td>
<td>Multiple Intelligences (Gardner, 1983)</td>
<td>Classroom-based nutrition education</td>
<td>1 x 40-minute session biweekly for 24 weeks (12 lessons total)</td>
<td>F&amp;V identification; snack choices; willingness to taste new foods; eating behavior</td>
</tr>
<tr>
<td>Hip Hop to Health Jr. (Fitzgibbon et al., 2005)</td>
<td>12 Head Start Centers</td>
<td>3-year randomized control trial with 1- and 2-year follow ups</td>
<td>3-5 years old; N = 409; Predominantly low income African American children</td>
<td>Social learning theory (Bandura, 1977), stages of change (Prochaska &amp; DeClemente, 1992)</td>
<td>Classroom-based nutrition education (“Go vs. Slow”), physical activity lessons, family component weekly newsletters, homework assignments, and twice weekly aerobics classes.</td>
<td>3 x 40-minute sessions/wk for 14 weeks (42 lessons total)</td>
<td>BMI; 24-hr dietary recalls; physical activity</td>
</tr>
<tr>
<td>Hip Hop to Health Jr. (Fitzgibbon et al., 2006)</td>
<td>12 Head Start Centers</td>
<td>3-year randomized control trial with 1- and 2-year follow ups</td>
<td>3-5 years old; N = 401; Predominantly low income Latino children</td>
<td>Social learning theory (Bandura, 1977), stages of change (Prochaska &amp; DeClemente, 1992)</td>
<td>Classroom-based nutrition education (“Go vs. Slow”), physical activity lessons, family component weekly newsletters, homework assignments, and twice weekly aerobics classes.</td>
<td>3 x 40-minute sessions/wk for 14 weeks (42 lessons total)</td>
<td>BMI; 24-hr dietary recalls; assessments of nutrition knowledge &amp; physical activity</td>
</tr>
<tr>
<td>I am Moving, I am Learning (Finkelstein et al., 2007)</td>
<td>53 Head Start centers in Philadelphia</td>
<td>Non-experiment</td>
<td>Unknown</td>
<td>Social learning theory (Bandura, 1977)</td>
<td>Optional classroom-based nutrition education &amp; physical activity lessons, family components</td>
<td>Ongoing</td>
<td>Survey assessing use and satisfaction with program</td>
</tr>
</tbody>
</table>
### Findings

**Menu:** Decrease in sat. fat & total fat served compared to controls. Cholesterol: exp. groups with menu mod. decreased total serum cholesterol levels & subjects with elevated cholesterol at baseline more likely to have cholesterol in normal range at post-test compared to controls. Knowledge: exposure to nutrition ed. resulted in greatest increases in nutrition knowledge at post-test. BMI: No difference at post-test.

**F&V identification:** significant increase from pre- to post-test. Willingness to taste new foods: significant increase from pre- to post-test. F&V consumption: significant increase from pre- to post-test.

**BMI:** No difference at post-test, but the exp group had significantly smaller increases in BMI at 1- and 2-year follow-up. Dietary intake: exp group had lower percentage of calories from saturated fat than controls at 1-year follow up, but no difference at post-test or 2-year follow up. Physical activity: no differences.

**BMI:** No differences. Dietary intake: No differences. Physical activity: No differences. TV viewing: No differences.

**Nutrition enhancements:** used in 67% of centers, less commonly used than physical activity enhancements.

### Study Strengths & Limitations

<table>
<thead>
<tr>
<th>Strengths</th>
<th>Limitations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strengths: Large sample size. Limitations: Did not assess F&amp;V consumption. No follow-up (authors use term “follow-up” to describe post-test).</td>
<td>Strengths: Large sample size. Limitations: No control group included in study design. Reliance on parent report to assess changes in eating behavior.</td>
</tr>
<tr>
<td>Strengths: 2-year follow up. Limitations: low retention rate. Poor parental compliance with family component. Measures of physical activity and dietary recall may not have been sensitive enough to detect changes.</td>
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</tr>
<tr>
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</tbody>
</table>
Chapter 3

Methodology

Participants and setting. This study was conducted in two urban public elementary schools in a large urban school district in the Northeastern part of the United States. All preschool children in grade K-1 attending the two schools were invited to participate in fall 2009. The two schools included in the study were selected based on principal and teacher interest rather than random selection. Only students whose caregivers signed a consent form were included in the study; however, all students in the intervention classrooms received the program. Sixty-six students from three classrooms at each school participated in the experimental and control groups. Demographic information about the sample including participation rate, age, BMI, gender, race/ethnicity, and percent of non-English speaking participants is summarized in Table 2. Participating school staff serving as interventionists included two lunch monitors, three classroom teachers, and three classroom assistants employed by the school district.

Table 2

Participant Demographic Information by Group

<table>
<thead>
<tr>
<th></th>
<th>Experimental (n = 44)</th>
<th>Control (n = 20)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Participation rate (%)</td>
<td>68</td>
<td>43</td>
</tr>
<tr>
<td>Mean age in years</td>
<td>5.1</td>
<td>4.9</td>
</tr>
<tr>
<td>BMI-for-age (% &gt; 85%tile)</td>
<td>23</td>
<td>38</td>
</tr>
<tr>
<td>Gender (% boys)</td>
<td>48</td>
<td>60</td>
</tr>
<tr>
<td>Race/ethnicity (%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>African American</td>
<td>42</td>
<td>40</td>
</tr>
<tr>
<td>Latino</td>
<td>16</td>
<td>28</td>
</tr>
<tr>
<td>Asian</td>
<td>35</td>
<td>9</td>
</tr>
<tr>
<td>White</td>
<td>3</td>
<td>19</td>
</tr>
<tr>
<td>Other</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Non-English spoken at home (%)</td>
<td>65</td>
<td>30</td>
</tr>
<tr>
<td>Eligibility for free and reduced lunch (%)</td>
<td>82</td>
<td>84</td>
</tr>
</tbody>
</table>
Multi-component vegetable promotion program. This one-month
Multi-component nutrition education program was developed using a participatory action research paradigm (Nastasi et al., 2000). Prior literature has demonstrated that this approach to research often results in the development and evaluation of potentially effective and acceptable interventions (Leff, Costigan & Power, 2004). By jointly developing implementation and evaluation procedures in partnership with school and community personnel, an intervention is more likely to be culturally responsive, ecologically valid, and acceptable to the school and the community (Nastasi et al., 2000). In the current study, the primary researcher collaborated with school administrators, teachers, teaching assistants and lunch monitors to design, implement, and evaluate the nutrition education program after vegetable consumption had been identified as problematic for students.

The program was developed according to concepts from ecological (Bronfrenbrenner, 1979) and social learning (Bandura, 1977) theories as well as behavioral psychology (Skinner, Skinner, Sterling-Turner, 2002). Ecological theory postulates that children are embedded in multiple, interacting environmental systems, with bidirectional influences within and between the systems. The school-based portion of the program provided students nutrition education in the classroom and lunchroom. Additionally, nutrition-related messages consistent with those provided in school were disseminated to caregivers. Because knowledge-based nutrition education in isolation has not been effective in generating behavior change (Blom-Hoffman & DuPaul, 2003, behavior change strategies rooted in social learning theory (Bandura, 1977) and operant
conditioning (Skinner, Skinner, & Sterling-Turner, 2002) were integrated into program components and are summarized in Table 3 along with the goals of each activity.

Elements of social learning theory embedded in the program include: (a) role models (i.e., teachers and lunch monitors); (b) observational learning; (c) repeated opportunities to retain nutrition-related information; and (d) daily opportunities to practice behaviors with contingent and vicarious reinforcement. The program’s main behavior change component, “Caught Eating Vegetables,” utilized operant conditioning (Skinner, Skinner, & Sterling-Turner, 2002) to reinforce students’ vegetable consumption during school lunch. Operant conditioning (Skinner, 1953) posits that behavior is affected by its consequences and, further, that positive reinforcement strengthens behavior thereby increasing the likelihood that it will recur.

In addition to psychological theory, the intervention was also developed according to recommendations put forth by the American Dietetic Association (2006) as well as the important components of fruit and vegetable promotion programs identified in the literature (Knai, 2006). The American Dietetic Association (2006) suggests using an ecological approach to treatment and prevention of childhood obesity with a combination of family-based and school-based multi-component programs that incorporate: (a) nutrition education; (b) behavioral components; (c) parent training/education; and (d) physical activity. Although it was unfortunately not feasible to include physical activity in this preliminary investigation, the current intervention did include components of effective fruit and vegetable promotion programs identified in prior studies (Knai, 2006) including (a) focus on fruit and vegetables rather than on nutrition in general, (b) active engagement in nutrition education activities, (c) social modeling by peers and symbolic
role models, (d) encouragement by lunch staff to eat F&V, and (e) active involvement by families. The program was implemented in the context of a public school system with a healthy eating policy.

Table 3

*Components of the Vegetable Promotion Program*

<table>
<thead>
<tr>
<th>Environmental Domain (Individuals Involved)</th>
<th>Activity</th>
<th>Activity Goals</th>
<th>Link to Psychological Theory</th>
</tr>
</thead>
<tbody>
<tr>
<td>Classroom (Classroom teachers &amp; Teaching Assistants)</td>
<td>F&amp;V of the Day posters</td>
<td>1. Increase visibility of the F&amp;V served in the school lunch.</td>
<td>Increase attention to &amp; retention of target information.</td>
</tr>
<tr>
<td></td>
<td>Fruit &amp; Vegetable toys</td>
<td>2. Provide opportunity for hands-on, student-directed play with model F&amp;V.</td>
<td>Influential role models highlight importance of F&amp;V in school lunch.</td>
</tr>
<tr>
<td></td>
<td>Meet Choozy DVD</td>
<td>3-4. Provide information and role modeling from animated characters.</td>
<td>Implement symbolic role modeling.</td>
</tr>
</tbody>
</table>
| | Choozy Kids CD | 5. Take simple messages home and create opportunities for children to share nutrition education with caregivers. | |}

<table>
<thead>
<tr>
<th>Lunchroom (Lunch Monitors &amp; Teaching Assistants)</th>
<th>Caught eating vegetables stickers</th>
<th>1. Provide reinforcement for eating behaviors.</th>
<th>Increase attention to &amp; retention of target information.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Peers perform live modeling.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Provide daily opportunities to practice target behavior.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Receive positive reinforcement from lunch monitors.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Home (Caregivers)</th>
<th>Two take-home activity books (Blom-Hoffman, 2006)</th>
<th>1. Provide parents with simple messages that are consistent with what children have learned.</th>
<th>Increase attention to &amp; retention of target information.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>2. Provide a context for parents and children to discuss information through shared book reading.</td>
<td>Implement symbolic role modeling.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Goal setting.</td>
</tr>
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<td></td>
<td></td>
<td></td>
<td>Self-monitoring.</td>
</tr>
</tbody>
</table>

**Classroom component.** Given the many demands of classroom teachers, the classroom component was developed to be time efficient and sensitive to competing
curricula. Classroom activities were designed to be participatory and hands-on as recommended by the Center for Disease Control’s Guidelines for School Health Programs to Promote Lifelong Healthy Eating (1996). In the classroom, daily 5-minute lessons introduced students to the fruit and vegetables served in the school lunch. Lessons included a tutorial in which participants were taught to associate food names with animated pictures of the fruit and vegetable being served that day (i.e., “Fruit and Vegetable of the Day”). Teachers participating in the program were provided a “Fruit and Vegetable of the Day” board and laminated pictures of the fruit and vegetable characters each with Velcro affixed to the back. Each day, students posted the fruit and vegetable characters that corresponded with what was being served in the school lunch to increase attention to and retention of nutrition information.

A complement to the fruit and vegetable identification module included a variety of hands-on activities (i.e., video and songs) that were recommended for use during nonacademic time (i.e., snack, transition, clean up) or as a center to attract students’ attention and actively engage them in the learning process. Teachers were encouraged to utilize the 3-minute “Meet Choosy” DVD to introduce students to the “Choosy” cartoon character who promotes healthy eating behavior and served as a symbolic role model. The DVD included songs and animation. Teachers were also encouraged to play songs from a CD that integrates music from two of the Choosy Kids CDs, “This is My Body” and “I am Moving, I am Learning,” into daily classroom activities. The following 10 nutrition-focused songs were recommended: Crave Your F.A.V., Stir the Soup #1, Stir the Soup #2, Be Choosy Be Healthy, My Heart Says Thanks, Make Me Feel Great #1, Mix it All Up, Make Me Feel Great #2, I’m Learning to Choose, and Choosy-Size Me.
The songs included upbeat music embedded with health messages that encourage children to make nutritious food choices and engage in physical activity. They also celebrated healthy decision-making and promoted prominent messages from the “I am Moving, I am Learning” curriculum (i.e., “Be Choosy Be Healthy”).

The classroom component also included opportunities for sociodramatic play with fruit and vegetable models (Pretend & Play Fruit Set and the Small World Living Toys Peel n’ Play Vegetable Set) during center time. Groups of three to five children played with the toy foods in kitchen centers containing a stove, cupboard, table and chairs, cookware, and plastic ware. Play behavior is reflective of early cognitive development and it fosters knowledge about the world (Lifter & Bloom, 1998). The activity provided children opportunities to increase their exposure to a variety of fruit and vegetables. It also permitted them to demonstrate knowledge of these foods via play with the toys and verbalizations of fruit and vegetable names during play. While the intervention was implemented on non-data collection days, teachers and/or teaching assistants facilitated a discussion with children in the kitchen center regarding the various foods used and food preparations they demonstrated. Teachers and/or teaching assistants also talked with children in the kitchen center about the names of the fruit and vegetables with which they played. Teachers and/or teaching assistants did not facilitate discussion with the fruit and vegetable toys during data collection days. In one classroom with primarily Vietnamese-speaking students, fruit and vegetable verbalizations were simultaneously observed, and fruit and vegetable verbalizations were translated by a Vietnamese teacher trained in observation procedures.
**Lunchroom component.** The lunchroom component involved lunch monitors “catching” students eating vegetables by providing them with verbal praise and a sticker contingent on eating one bite of these foods. “Caught Eating Vegetables” (based on Blom-Hoffman et al., 2004; Blom-Hoffman, 2008; Hoffman et al., 2010) is a behavioral intervention that was designed to encourage fruit and vegetable consumption via peer role modeling, and vicarious and direct reinforcement. Students were directly reinforced and observed their peers being reinforced with verbal praise and stickers for taking one bite of a vegetable in the school lunch. Brightly-colored stickers (Appendix A) were developed using animated characters that served as symbolic role models and were introduced to children in the program’s classroom and family components. The stickers were a cost efficient manner for rewarding students for vegetable consumption during school lunch. Costs associated with this component were approximately $0.04/sticker (Blom-Hoffman et al., 2008).

**Family involvement.** Caregivers were provided with nutrition-related messages that were consistent with the material disseminated to children in the classroom via two interactive children’s books, “Fruits & Veggies More Matters” and “Crave Your Colors,” which were designed for parents to read with children and are based on the family component described in Blom-Hoffman et al. (2008). The “Fruits & Veggies More Matters” book (Appendix B) was written on a 4.4th grade Flesch-Kincaid reading level and introduced children and their parents to the goal of consuming *more* fruit and vegetables each day and different ways to meet this goal. To connect the school and family intervention components, parents were also introduced to the “Choosy” character and his purpose of promoting healthy decision-making among young children. The book
included a short parent letter, activities (i.e., drawing and coloring) requiring adult assistance, and a brief parent and child questionnaire at the end. The “Crave Your Colors” book (Appendix C) was written on a 6.6th grade Flesch-Kincaid reading level and encouraged children and their parents to eat a variety of fruit and vegetables in different colors. The book included a short parent letter, activities (i.e., drawing, coloring, goal setting, and self-monitoring) requiring adult assistance, and a brief parent and child questionnaire at the end. Activities provided an engaging, interactive format through which parents and young children could have conversations about the importance of eating fruit and vegetables. Children had multiple opportunities to respond through active engagement (Greenwood, Delaquadri, & Hall, 1984). The book also reinforced messages that students learned in the classroom.

**Measures**

The multi-component nutrition education program described above was the independent variable. Dependent variables included: students’ eating behavior as measured by weighed plate waste and knowledge of fruit and vegetables as evaluated by a brief fruit and vegetable identification pre- and post-test, and verbalizations of fruit and vegetable names during play. Program acceptability and treatment integrity were also measured.

**Weighed plate waste.** Vegetable consumption was assessed using direct measurements of these foods eaten during school lunch, consistent with the procedures described in Hoffman et al. (2010). Vegetable intake was assessed during three lunches both pre- and post-intervention. Data collection days were determined according to the school lunch schedule so that similar foods (i.e., cooked green vegetable, mixed
vegetables, and raw carrots) were assessed across data collection phases and schools. As described by Hoffman et al. (2010), three school lunches were purchased prior to lunch to determine the average portion sizes served.

Trained research assistants (RAs) blind to study purposes, hypotheses and group assignments, observed children throughout the lunch periods and collected lunch trays. All children wore nametags so RAs were able to identify them. When students finished eating, they were instructed to place their nametag on their lunch tray. While observing children in small groups, RAs recorded food items on the trays (Appendices D & E). RAs also noted food that was traded and/or spilled. It was inferred that food that was not traded or spilled was consumed during lunch. To assess reliability of direct observations, two independent RAs simultaneously observed 76% of students across the study. Kappa coefficients were computed to assess inter-observer agreement for vegetables (Kappa range = 0.92-1.0) and reflected “almost perfect” agreement (Landis & Koch, 1977).

At the end of the lunch periods, trays of students who took the school lunch were weighed on a food scale (Salter Model 2006, Kent, England). Only vegetables served in the school lunch were measured. The scale was checked for accuracy using calibration weights. Vegetable consumption was calculated as follows: Initial mean portion served in grams minus amount of food left on the tray in grams.

Knowledge change. Knowledge change was evaluated using a brief authentic assessment that evaluated students’ ability to identify fruit and vegetables served in the school lunch. The knowledge test included seven 4” X 6” photographs of different school lunches arranged into a flipbook with one photograph per page. Children were asked to point to and name the fruit and vegetable depicted in each lunch. Students
obtained a fruit and vegetable identification score (between 0-22 points) and a fruit and vegetable naming score (between 0-22 points). The knowledge assessment was administered by trained RAs one week prior to the implementation of the program and during the final week of program implementation.

A reliability study was conducted to assess 2-week test-retest reliability of the knowledge tool. A separate group of preschool students were recruited from another school to participate (Appendix L). Students whose parents consented to their participation (N = 30) were administered the knowledge questionnaire twice with two weeks in between administrations. Pearson’s r coefficients were computed to assess two-week test-retest reliability for F&V Identification (r = .87) and F&V Naming (r = .87).

Knowledge change was also evaluated with direct observations of kitchen center-based play. Play observations occurred twice weekly during the four-week intervention and the number of fruit and vegetable names that children verbalized during play were recorded by the lead researcher. Vietnamese students’ play was observed by their Vietnamese teacher who translated fruit and vegetable verbalizations. All children wore name tags so they could be identified.

**Intervention acceptability.** Program acceptability was assessed to determine the degree to which students, classroom assistants, teachers, lunch monitors, and parents perceived the intervention as acceptable. Student acceptability of the intervention was assessed using a modified version of the Children’s Intervention Rating Profile (CIRP; Elliott, 1986). Students were asked to evaluate the program by providing ratings on a four-point Likert scale (Appendix F). In order to assist children with the ratings, they were asked to point to smiling and frowning faces to indicate the degree to which they
liked the program. The questionnaire was administered individually and questions were read aloud to the children.

Adult acceptability was measured using modified versions of the Intervention Rating Profile (IRP; Martens & Witt, 1982). Classroom assistants, teachers, and lunch monitors were asked to evaluate the program by providing ratings on a six-point Likert scale (Appendices G & H). Parents and children completed a short questionnaire at the end of both children’s books that comprised the program’s family component and these data indicated the degree to which the books were perceived as acceptable by both adults and children.

**Treatment integrity.** Treatment integrity was assessed to verify that the lunchtime and classroom intervention components were implemented as they were intended. Integrity checks were conducted across 40% of the lunches to determine if lunch stickers were distributed to students contingent upon vegetable consumption. The rate at which stickers needed to be replenished was a second method of assessing the degree to which lunch stickers were distributed to students during lunch. Treatment integrity was also assessed in the classroom. Teachers were asked to use a data recording sheet (Appendix I) to log the type of fruit or vegetable included in the “Fruit and Vegetable of the Day” lesson and the date(s) during which the teacher utilized the “Fruit and Vegetable of the Day” board to teach students to associate fruit and vegetable characters with their names. Teachers were provided with a second data-recording sheet (Appendix J) for logging the frequency of DVD, CD, and F&V toy use. Student engagement in classroom activities was also assessed by teachers and recorded on treatment integrity logs. Finally, treatment integrity for the family component was
assessed using the children’s books as permanent products. The degree to which books were returned and activities completed was analyzed.

**Materials**

Classroom teachers were provided with a “Fruit and Vegetable of the Day” board and laminated pictures of the fruit and vegetable characters each with Velcro affixed to the back. Teachers utilized the board as a method of teaching young students to identify fruit and vegetables served in the school lunch using symbolic role models. Teachers were also supplied with interactive and engaging nutrition education activities (i.e., video and songs) from the “I am Moving, I am Learning” program featuring Choosy, another symbolic role model. Teachers were provided the Learning Resources Pretend & Play Fruit Set and the Small World Living Toys Peel n’ Play Vegetable Set. Teachers were asked to distribute materials for the family component of the program, which consisted to two interactive children’s books that were disseminated as homework. The books encouraged parent-child interaction and dialogue around nutrition education through questions and activities embedded throughout the books. Parents were asked to return the books to teachers. Materials for the lunchtime component included brightly colored lunch stickers featuring fruit and vegetable characters introduced to students in the classroom and family components.

**Research Design**

A pre-test/post-test quasi-experimental design with control group was utilized to evaluate the efficacy of this multi-component nutrition education program in increasing vegetable consumption and knowledge of fruit and vegetables in a feasible and acceptable way. Experimental and control groups were matched according to school
district, grade, percent of children eligible for free or reduced price lunch, grade, and food service plan (i.e., onsite cafeteria vs. satellite cafeteria). Both schools utilized satellite kitchens to provide the school lunches, so that food was prepared off-site and was reheated at school. Schools rather than participants were randomly assigned to comparison groups by the lead researcher. Both groups received the same pre- and post-test measures. There were three phases of this study: phase 1 (pre-baseline), phase 2 (baseline assessments for both groups); phase 3 (post-test for the intervention group; a second baseline assessment for the control group).

Procedures

Pre-baseline. Approval was obtained from the Institutional Review Boards at Northeastern University and the participating school district. School principals’ permission was obtained, and children were recruited to participate in the outcome evaluation (Appendix K). The F&V knowledge measure was also developed during the pre-baseline phase of the study.

Training and PAR procedures. Ten research assistants (RAs) attended two 60-minute training sessions during which they were trained to administer knowledge and acceptability measures, and to collect plate waste data during lunch observations (Appendix M). The lead researcher demonstrated all study procedures. RAs role played the procedures and received feedback. Scripts were provided to ensure standardized administration procedures.

Two lunch monitors and three teaching assistants regularly serving as lunch monitors met with the primary researcher during two, half-hour meetings in which a participatory action approach was utilized and lunch staff were trained on lunchtime
intervention procedures. Lunch monitors identified insufficient vegetable consumption as being problematic for preschool students. They noted that large portions of vegetables are frequently left uneaten and are discarded at the end of lunch. Lunch monitors were introduced to the proposed lunchtime component of the program and its purpose of increasing students’ vegetable consumption during school lunch. They were asked to: (a) encourage students to taste the vegetable served, (b) provide verbal praise to students who consumed one bite of their vegetable, and (c) distribute stickers once students consumed one bite of the vegetable on their lunch tray. The lead researcher engaged lunch monitors in a discussion regarding the feasibility of the intervention during lunchtime and changes were made to aspects of the intervention as suggested to facilitate buy-in and acceptability of the program. Lunch monitors reported that the lunchtime intervention was in large part feasible and acceptable to them. They compromised with one another to select the location for storing stickers in the lunchroom. Lunch monitors also made suggestions to the lead researcher regarding the position children’s nametags in order to more easily identify study participants during data collection.

Three teachers attended two, half-hour training meetings to develop and learn procedures for the classroom component. Teachers were in agreement that students ate few vegetables during lunch and that they would benefit from a school-based intervention to help students eat more vegetables at lunchtime. Teachers were introduced to the proposed classroom component and their feedback regarding acceptability and feasibility was solicited.

Teachers discussed potential daily nutrition education lessons that would introduce students to the fruit and vegetables served each day in the school lunch. The
lead researcher suggested using the “Fruit and Vegetable of the Day” board with which students were taught to associate food names with fruit and vegetable characters that correspond to the fruit and vegetable being served that day (i.e., “Fruit and Vegetable of the Day”).

In addition, teachers were encouraged to complement the lessons with engaging activities (i.e., video, songs, and toys) that attract students’ attention and actively engage them in the learning process during nonacademic time (i.e., snack, transition, clean up) or as a center. Teachers were encouraged to utilize the Meet Choosy DVD to introduce students to the Choosy cartoon character who was a symbolic role model for them. Teachers were also encouraged to integrate songs from two of the Choosy Kids CDs, “This is My Body” and “I am Moving, I am Learning,” into daily classroom activities. Teachers were asked to provide students the opportunity to use fruit and vegetable toys in the kitchen center to increase exposure to these foods. Teachers suggested that they facilitate discussion between children in the kitchen center regarding the fruit and vegetable toys being used in order to increase familiarity with fruit and vegetable names. The lead researcher agreed that this would be beneficial; however, they were encouraged to avoid this type of discussion during data collection days. Teachers were asked to provide verbal praise to students who received lunch stickers and verbal encouragement to students who did not receive stickers during school lunch. Teachers and assistants were also asked to distribute family component materials (i.e., two interactive children’s books) to students and collect the books as homework assignments with two weeks.

Classroom teachers provided feedback regarding acceptability and feasibility of the intervention’s classroom component. Teacher feedback to the lead researcher
included the following: (a) utilization of an interdependent group contingency based on lunch stickers received was not feasible in combination with other program components; (b) collection of students’ lunch stickers on a chart was perceived as unnecessary; and (c) revisions to the classroom treatment integrity log were suggested to enhance user-friendliness. The intervention was adapted to incorporate teachers’ feedback and recommendations.

**Baseline.** Trained RAs reviewed data collection procedures with the lead researcher immediately before each day of data collection. The lead researcher was present for each day of data collection to answer questions regarding study procedures. RAs administered baseline knowledge measures to students in the experimental and control groups prior to program implementation. Prior to beginning administration procedures, children’s verbal assent was obtained. Children were read aloud a statement (Appendix N) and were asked if they would like to participate. RAs also collected plate waste data during three lunches at both the experimental and control schools. Data collection days were determined according to the school lunch schedule so that similar foods (i.e., cooked green vegetable, mixed vegetable, and raw carrots) were assessed across phases. Pre-test knowledge and acceptability measures and plate waste data were collected across three days at each school prior to program implementation.

**Intervention.** The multi-component nutrition education program was implemented for four weeks during the 2009-2010 school year. The lead researcher monitored implementation of the program during weekly, unannounced fidelity checks in classrooms and the lunchroom. Programmatic questions were answered and brief problem solving sessions were held during fidelity checks and also using email for
communication. Due to time constraints, teachers, classroom assistants, and lunch monitors were unable to attend regularly scheduled meetings to problem solve challenges that arose during program implementation.

**Post-test.** Post-test knowledge and acceptability measures and plate waste data were collected across three days at each school during the final week of program implementation while the intervention was in place in the experimental school.

**Data Analyses**

A power analysis was conducted with $\beta=0.80$, $\alpha=0.05$ and an effect size of Cohen’s $d=0.34$ observed in prior literature (Hoffman, 2010) using the G*Power 3 application (Faul, Erdfelder, Lang & Buchner, 2007) to determine the minimum number of participants required for the study. A minimum of 40 total students was required with at least 20 students per group.

**Behavior change.** Data screening procedures examined accuracy of data entry, missing plate waste measurements, outliers, and fit between their distributions and the assumptions of parametric statistics. Two outliers were excluded from analysis. Cases with missing data were not excluded due to the small number ($\leq 5$) of missing values per lunch observation. The approach used for replacing missing data was to impute the series mean, as suggested by Tabachnick and Fidell (2001). Assumptions for using parametric tests were assessed prior to analyzing vegetable consumption data and it was determined that the assumptions (e.g., normal distribution of data and homogeneity of variance) were violated ($p < .01$). The variables were initially transformed and the data continued to be non-normal. As a result, nonparametric statistics were used to test behavior change hypotheses. To test the hypothesis that children participating in the multi-component
nutrition education program would eat more of their vegetables during school lunch at
post-test relative to their pre-test, a Wilcoxon signed-rank test (Wilcoxon, 1945) was
computed.

To test the hypothesis that preschool students participating in the multi-
component nutrition education program would eat more of their vegetables during school
lunch relative to a comparison group, a Mann-Whitney $U$-test (Mann & Whitney, 1947)
was computed. The magnitude of the treatment effect size was computed by converting
the $z$-score using the equation $r = Z/\sqrt{N}$ (Rosenthal, 1991). Based on prior literature
(Hoffman et al., 2010), it was hypothesized that the magnitude of the effect for changes
in vegetable consumption would be small to medium using Cohen’s $d$, where $d$ values
approximating 0.2 have been considered “small,” 0.5 are “medium,” and 0.8 are “large”
(Cohen, 1988).

Knowledge change. Data screening procedures examined accuracy of data entry,
missing knowledge values, outliers, and fit between their distributions and the
assumptions of parametric statistics. No outliers or missing data were identified.
Assumptions for using parametric tests were assessed prior to analyzing knowledge
change data and it was determined that the assumptions (e.g., normal distribution of data
and homogeneity of variance) were met. To test the hypothesis that at post-test, children
in the experimental group would show greater knowledge relative to baseline and relative
to students in the control group, two 2 x 2 ANOVAs with repeated measures were
computed to examine main effects for time, group, and group X time interactions. The
first factor represented Group (i.e., experimental and control) and the second factor was
Time (i.e., pre-test, post-test). Knowledge assessment naming and identification scores
were the dependent variables. Descriptive statistics were used to analyze fruit and vegetable verbalizations during play.

**Intervention acceptability.** Descriptive statistics were used to assess intervention acceptability among students, teachers, teaching assistants, lunch monitors, and parents.

**Treatment integrity.** To test the hypothesis that teachers and classroom assistants implemented the intervention with acceptable levels of integrity, unannounced fidelity checks across 40% of program implementation days as well as self-report (i.e., data recording sheets used to log “Fruit and Vegetable of the Day” identification lessons and use of songs, video, and fruit and vegetable toys) were used to evaluate the extent to which the classroom components were implemented as they were intended. Mean daily percentage of integrity was calculated by dividing the number of steps observed to be followed by the teacher on the integrity checklist by the total number of steps on the checklist and multiplied by 100%. Mean percentage by activity was calculated by dividing the number of days each activity was observed to be carried out by the teacher divided by the total number of observations and multiplied by 100%. Treatment integrity was also assessed using a measure of student engagement. Teachers rated engagement of each classroom activity on a 4-point Likert scale (4 = Not at all, 3 = Not much, 2 = A little, 1 = Not at all).

To test the hypothesis that lunch monitors implemented the “Caught Eating Vegetables” intervention as it was intended during lunchtime, unannounced lunchtime fidelity checks were conducted across 40% of lunch periods to evaluate whether praise and lunch stickers were provided to students contingent upon vegetable consumption.
Mean daily percentage of integrity was calculated by dividing the number of steps observed to be followed by the lunch monitor by the total number of steps on the checklist and multiplied by 100%.
CHAPTER 4

Results

Described below are the specific research questions and hypotheses addressed in the current study, the analyses used to answer each question, and the corresponding data.

Behavior change. Research Question #1: Is the multi-component nutrition education intervention effective in increasing preschool students’ vegetable consumption? Hypothesis #1: It was hypothesized that students participating in the multi-component nutrition education intervention would consume more of their vegetables during school lunch relative to their baseline and relative to students in a comparison group.

Assumptions for using parametric tests, such as the repeated measures ANOVA, include the normal distribution of data, homogeneity of variance, and interval data. To test the normal distribution of data, z-scores of skewness and kurtosis were computed. At pre- and post-test, vegetable consumption data were positively skewed (z = 7.34 and 4.30 respectively, \( p < .001 \)) and leptokurtic (z = 8.31 and 3.83 respectively, \( p < .001 \)). Results from Levene’s test indicated that the variances were significantly different for the experimental and control groups at pre-test, \( F(1, 64) = 7.28, p < .01 \), but the variances were not different, \( F(1, 64) = 2.96, p = .09 \), at post-test. The assumptions for analyzing vegetable consumption data with a repeated measures ANOVA were not met due to violations of normality and homogeneity of variance (\( p < .01 \)). Thus, the data were analyzed using nonparametric statistics described below.

To test the hypothesis that children participating in the multi-component nutrition education program would eat more of their vegetables during school lunch at post-test
relative to their pre-test, a Wilcoxon signed-rank test (Wilcoxon, 1945) was computed. The magnitude of the treatment effect size was computed by converting the $z$-score using the equation $r = \frac{Z}{\sqrt{N}}$ (Rosenthal, 1991) with a small effect size = .20, a medium effect size = .50, and a large effect size = .80 (Cohen, 1988). The Wilcoxon signed-rank test indicated that students in the experimental group significantly increased their vegetable consumption from pre-test to post-test, $z = 2.594, p < .01, r = .29$. There were no differences in vegetable consumption from pre-test to post-test for children in the control group, $z = -0.363, p = .358, r = .05$ (see Figure 1). These results support the hypothesis that preschool students participating in the multi-component nutrition education program would eat more of their vegetables during school lunch at post-test relative to their pre-test.

![Figure 1](image)

*Figure 1.* Display of the mean vegetable intake at pre-test and post-test for students in the experimental and control groups.

To test the hypothesis that preschool students participating in the multi-component nutrition education program would eat more of their vegetables during school lunch relative to a comparison group, a Mann-Whitney $U$-test (Mann & Whitney, 1947)
was computed. The magnitude of the treatment effect size was computed using conversions of the $z$-score into $r$ (see equation above; Rosenthal, 1991).

The Mann-Whitney $U$-test indicated that students in the experimental group consumed significantly less vegetables during school lunch at pre-test relative to students in the comparison group, $U = 350.5, z = -2.225, p < .05, r = .27$. However, at post-test there was no significant difference in vegetable consumption between the two groups, $U = 440.0, z = -1.05, p = .29, r = .13$. Thus, significant increases in vegetable consumption for the experimental group that occurred during the program eliminated the statistical difference between the two groups at post-test. However, the hypothesis that preschool students participating in the multi-component nutrition education program would eat more of their vegetables during school lunch relative to a comparison group was not supported.

**Knowledge change.** Research Question #2: Is the multi-component nutrition education intervention effective in increasing preschool students’ knowledge of fruit and vegetables? Knowledge of fruits and vegetables was measured three ways: (a) naming fruit and vegetables, (b) identifying foods as fruit and vegetables, and (c) using fruit and vegetable names during play. Hypothesis #2a: It was hypothesized that students participating in the multi-component nutrition education intervention would name more fruit and vegetables at post-test relative to pre-test and to students in a comparison group. Hypothesis #2b: It was hypothesized that students participating in the multi-component nutrition education intervention would correctly identify more foods as fruit and vegetables at post-test relative to pre-test and to students in a comparison group. Hypothesis #2c: It was hypothesized that students participating in the multi-component
nutrition education intervention would increase fruit and vegetable verbalizations during play throughout the one-month intervention.

To test the normal distribution of naming data, z-scores of skewness and kurtosis were computed. Naming data were normally distributed at pre-test and post-test ($z = 1.05$ and 0.21 respectively, $p < .05$) and $z$-scores for kurtosis were non-significant at pre-test ($z = -0.16$, $p < .05$) and post-test ($z = 0.08$, $p < .05$). In the control group, naming data at pre-test, $D(26) = 0.09$, $p = .20$, and at post-test, $D(26) = 0.14$, $p = .20$, were normally distributed. Levene’s test indicated that the variances for the experimental and control groups were equivalent at pre-test, $F(1, 64) = 1.60$, $p = .21$, and post-test, $F(1, 64) = 2.12$, $p = .15$. Thus, assumptions for analyzing naming data using parametric statistics were met.

To test the hypothesis that children participating in the multi-component nutrition education intervention would correctly name more fruit and vegetables following the intervention relative to their pre-test and to students in a comparison group, a 2 x 2 ANOVA with repeated measures was computed. The first factor represented Group (i.e., experimental and control) and the second factor was Time (i.e., pre-test and post-test). $\eta^2$ was used to measure the magnitude of the treatment effect size with a small effect size $= .20$, a medium effect size $= .50$, and a large effect size $= .80$ (Cohen, 1988). The Time X Group interaction, $F(1, 64) = 2.239$, $p = 0.695$, $\eta^2 = .034$, observed power $= .314$ was non-significant. The main effect for Time was significant, $F(1, 64) = 10.339$, $p < 0.01$, $\eta^2 = .140$, observed power $= .888$, indicating that children in both groups improved from pre-test to post-test (see Figure 2).
Figure 2. Display of the mean correct fruit and vegetables named at pre-test and post-test for students in the experimental and control groups.

The same analytic approach was used to examine differences in fruit and vegetable identification. First, $z$-scores of skewness and kurtosis were computed. Fruit and vegetable identification data were normally distributed at pre- and post-test ($z = 1.92$ and 1.63 respectively, $p < .05$) and $z$-scores for kurtosis were non-significant at pre-test ($z = -0.47, p < .05$) and post-test ($z = -0.79, p < .05$). Fruit and vegetable identification data were also normally distributed for the control group at pre-test, $D(26) = 0.11, p = .20$, and post-test, $D(26) = 0.12, p = .20$. Levene’s test indicated that the variances for the experimental and control groups were equal at pre-test, $F(1, 64) = 0.002, p = 0.97$, and post-test, $F(1, 64) = 0.16, p = 0.69$. Thus, assumptions for analyzing fruit and vegetable identification data using parametric statistics were met.

To test the hypothesis that children participating in the multi-component nutrition education intervention would correctly identify more fruits and vegetables following the intervention relative to pre-test and to students in a comparison group, a $2 \times 2$ ANOVA with repeated measures was computed. The first factor represented Group (i.e., experimental and control) and the second factor was Time (i.e., pre-test and post-test).
The Time X Group interaction, $F(1, 64) = 0.032, p = 0.43, \eta^2 = .000$, observed power = .054, and main effect for Time, $F(1, 64) = 1.457, p = 0.116, \eta^2 = .022$, observed power = .221, were non-significant. Thus, there were no differences in the way students in the experimental and control groups identified foods as fruit and vegetables, nor were there differences in the way students in the experimental group identified fruits and vegetables before and after the intervention. A graphic display of the plotted means can be seen in

![Graph showing the number of correctly identified fruits and vegetables by experimental and control groups at pre-test and post-test.](image)

*Figure 3. Display of the mean correct fruit and vegetables identified at pre-test and post-test for students in the experimental and control groups.*

To test the hypothesis that students participating in the multi-component nutrition education intervention would increase their fruit and vegetable verbalizations during free play with fruit and vegetable toys at a kitchen center throughout the 4-week intervention, descriptive statistics were computed. Observational data indicated that students spoke minimally while playing with fruit and vegetable toys during center time, and they appeared to prefer playing with the toys silently. Despite the little communication between students in the kitchen center, they appeared to enjoy playing with the fruit and vegetable models and they were observed to consistently use them during socio-dramatic
Students were observed to “cut” the foods, “cook” them on the stove, and “serve” them to peers. Surprisingly, there was no clear increase in fruit and vegetable verbalizations over time (Range = 2-9 fruit or vegetable verbalizations per 15-min observation). A graphic display of the plotted means can be seen in Figure 4.

**Figure 4.** Display of mean number of fruit and vegetable verbalizations during play throughout the 4-week intervention.

**Treatment integrity.** Research Question #3: To what extent are lunch monitors able to implement the lunchtime component of the intervention with integrity? Hypothesis #3: It was hypothesized that lunch monitors would implement the lunchtime component of the intervention (i.e., provide stickers contingent on one bite of vegetable) on at least 80% of days observed over a 4-week period.

Integrity checks for the lunchtime component of the program were conducted on 40% of program implementation days. Mean daily percentage of integrity was calculated by dividing the number of steps observed to be followed by the lunch monitor by the total number of steps on the checklist and multiplied by 100%. Overall, integrity for the “caught eating vegetables” lunchtime procedures was variable ($M = 77\%$, Range = 33%)
to 100%). Treatment integrity was notably lower on indoor recess days, and it increased dramatically during the second half of program implementation. Ninety-seven percent of students reported having received lunch stickers and approximately half (51%) of students correctly described the requirement for receiving a lunch sticker (i.e., “eat your vegetables”). Based on these results, treatment integrity for the implementation of the lunch component was slightly lower than hypothesized.

**Intervention acceptability.** Research Question #4: To what extent are teachers able to implement the nutrition education classroom component of the intervention with integrity? Hypothesis #4: It was hypothesized that teachers would implement the nutrition education classroom component of the intervention with acceptable (i.e., 80%) levels of treatment integrity.

Treatment integrity checks for the classroom components of the program were conducted on 40% of program implementation days. Mean daily percentage of integrity was calculated by dividing the number of steps observed to be followed by the teacher on the integrity checklist by the total number of steps on the checklist and multiplied by 100%. Mean percentage by activity was calculated by dividing the number of days each activity was observed to be carried out by the teacher divided by the total number of observations and multiplied by 100% (see Table 4 for treatment integrity data across the three classrooms). Treatment integrity was also assessed using a measure of student engagement. Teachers rated engagement of each classroom activity on a 4-point Likert scale (4 = A lot, 3 = A little, 2 = Not much, 1 = Not at all).

On average, treatment integrity was moderate ($M = 45\%$); however degree of treatment integrity varied dramatically by activity. In general, teachers implemented the
“Fruit and Vegetable of the Day” activity ($M = 84\%$) and play with fruit and vegetable toys during center time ($M = 96\%$) with good integrity. In contrast, problems arose with implementation of the CD and DVD. These components were implemented with very low levels of integrity ($M = 4\%$ and $M = 0\%$ respectively). Anecdotally, teachers reported that the CD was “difficult to understand” and that the DVD was difficult to use without a television or projection screen in the classroom. Based on these results, treatment integrity for the implementation of the classroom component was much lower than hypothesized.

Table 4

*Treatment Integrity in the Three Experimental Classrooms*

<table>
<thead>
<tr>
<th>Classroom</th>
<th>Activity</th>
<th>Mean Percentage by Activity</th>
<th>Mean Daily Percentage</th>
<th>Daily Range</th>
<th>Level of Student Engagement</th>
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<tbody>
<tr>
<td>1</td>
<td>F &amp; V of Day</td>
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<td>50%</td>
<td>25%-75%</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>F &amp; V Toys</td>
<td>100%</td>
<td>13%</td>
<td>0%</td>
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</tr>
<tr>
<td></td>
<td>CD</td>
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<td>0%</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>2</td>
<td>F &amp; V of Day</td>
<td>75%</td>
<td>41%</td>
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</tr>
<tr>
<td></td>
<td>F &amp; V Toys</td>
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<td>0%</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td>CD</td>
<td>0%</td>
<td>0%</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td>DVD</td>
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<td>0%</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>3</td>
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<td>88%</td>
<td>47%</td>
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</tr>
<tr>
<td></td>
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<td>0%</td>
<td>N/A</td>
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</tr>
<tr>
<td></td>
<td>CD</td>
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<td>0%</td>
<td>N/A</td>
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</tr>
<tr>
<td></td>
<td>DVD</td>
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<td>0%</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Total</td>
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<td>46%</td>
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</tr>
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<tr>
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<tr>
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<td>DVD</td>
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<td>0%</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Research Question #5: Is the lunch component of the program acceptable to the lunch monitors implementing it? Hypothesis #5: It was hypothesized that the lunch
component would be acceptable (i.e., $M \geq 5.0$ on 6-point scale) to lunch monitors based on prior research (Blom-Hoffman, 2008).

Five of five paraprofessionals completed the lunch monitor acceptability questionnaire, which consisted of 10 items, and were rated on a 6-point Likert scale ($6 = strongly \text{ agree}$, $5 = agree$, $4 = slightly \text{ agree}$, $3 = slightly \text{ disagree}$, $2 = disagree$, $1 = strongly \text{ disagree}$). Higher ratings indicated that the program was more acceptable to lunch monitors. Based on their ratings, all of the lunch monitors indicated that the lunch component was acceptable to implement ($M = 5.24$, Range = 4.4-5.8). Based on these ratings, the hypothesis that the lunch component would be perceived as acceptable to lunch monitors in the experimental group was supported.

Research Question #6: Is the classroom component of the program acceptable to the teachers implementing it? Hypothesis #6: It was hypothesized that the program would be acceptable (i.e., $M \geq 5.0$ on 6-point scale) to the teachers based on prior research (Blom-Hoffman, 2008).

Three of three teachers completed the teacher acceptability questionnaire, which consisted of 19 items, and were rated on the same 6-point Likert scale ($6 = strongly \text{ agree}$, $5 = agree$, $4 = slightly \text{ agree}$, $3 = slightly \text{ disagree}$, $2 = disagree$, $1 = strongly \text{ disagree}$) with higher ratings indicating that the program was more acceptable to the teacher. Based on their ratings, all of the teachers indicated that the classroom component was acceptable to implement ($M = 5.02$, Range = 3.67-5.67). Notably, teachers reported that the program was not disruptive to the class ($M = 5.02$, $SD = 0$) and that it was beneficial for the preschool children who received it ($M = 5.33$, $SD = 0.58$). Regarding the CD and DVD, teachers indicated that they are acceptable ways to
encourage students to eat fruits and vegetables ($M = 4.67, SD = 0.58$) despite not utilizing them in the classroom. Teachers may have required more training in using the CD and DVD due to their response regarding technical skill required ($M = 3.67, SD = 1.52$). Based on these ratings, the hypothesis that the classroom component would be perceived as acceptable to teachers in the experimental group was supported.

Research Question #7: Is the program acceptable to the students participating in it? Hypothesis #7: It was hypothesized that the program would be acceptable (i.e., $M \geq 3.5$ on 4–point scale) to the students based on prior research (Blom-Hoffman, 2008).

Thirty-seven of 40 students in the experimental group (i.e., 92.5%) completed the student acceptability questionnaire, which consisted of 4 items, and were rated on a 4-point Likert scale (4 = A lot, 3 = A little, 2 = Not much, 1 = Not at all). Higher ratings indicated that the program was more acceptable to students. Based on their ratings, acceptability was high among students ($M = 3.51$, Range = 3.30-3.62), and the hypothesis that the program would be perceived as acceptable to students in the experimental group was supported.

Research Question #8: How acceptable is the shared book reading family component to caregivers? Hypothesis #8: It was hypothesized that caregivers would report the family component to be highly acceptable ($M \geq 2.5$ on a 3-point rating scale) based on prior research (Blom-Hoffman et al., 2008).

Twenty-six of 40 students in the experimental group (i.e., 65%) returned the Fruit and Vegetables More Matters family book, which consisted of 2 items that assessed parent acceptability, and were rated on a 3-point Likert scale (3 = A lot, 2 = A little, 1 = Not at all). Higher ratings indicated that the program was more acceptable to parents.
Based on their ratings, parents enjoyed this shared book reading activity ($M = 2.88, SD = .33$) and perceived the book to be informative ($M = 2.73, SD = .60$). Additionally, 21 of 40 students in the experimental group (i.e., 52.5%) returned the Crave Your Colors family book, which also consisted of 2 items that assessed parent acceptability, and were rated on the same 3-point scale. Based on their ratings, parents enjoyed this shared book reading activity ($M = 2.85, SD = .36$) and perceived the book to be informative ($M = 2.90, SD = .44$). The hypothesis that the family component of the program would be perceived as acceptable to caregivers in the experimental group was supported.
Chapter 5

Discussion

This chapter summarizes the findings of this study, describes its strengths and limitations and suggests directions for future research.

Summary of the findings. The theory-based, multi-component nutrition education intervention was implemented in three preschool classrooms in an urban elementary school in the Northeastern part of the United States. Three classrooms in a second elementary school from the same school district, matched by grade, type of school food service, and percent of children eligible for free or reduced price lunch, comprised the waitlist control group. A pre-test/post-test quasi-experimental design with a control group was utilized to evaluate how the program impacted students’ vegetable consumption and their knowledge of fruits and vegetables. Additionally, implementation integrity of the classroom and lunchroom components was assessed, as were teacher, lunch monitor, and student perceptions of program acceptability.

Treatment integrity. Treatment integrity data were collected across program components using multiple methods (e.g., direct observations and self-reports) and data showed that the level of integrity with which each component was implemented varied. Lunch monitors generally implemented the program’s main behavior change component, “Caught Eating Vegetables,” as it was intended on most days. In contrast, there was variability in the extent to which the classroom components were implemented by teachers. Students were consistently exposed to the teacher-led “Fruit and Vegetable of the Day” activity board and sociodramatic play with fruit and vegetable toys. Difficulties arose with implementation of the DVD and CD. Technological limitations and set up
time and effort might have contributed to implementation problems. Because *I am Moving, I am Learning* was not evaluated as extensively as other programs reviewed, the extent to which other schools utilize the DVD and CD remains unknown. Although the classroom components were designed to require little staff time, treatment integrity data suggest that four nutrition education activities may have been overly burdensome for teachers.

**Intervention acceptability.** Teachers and lunch monitors viewed the classroom and lunchroom components positively. A participatory action approach (Nastasi et al., 2000) was utilized to determine implementation logistics and it is likely that this approach impacted program acceptability. Prior research has shown that a participatory action research approach has been an effective method for developing acceptable interventions (Leff, Costigan, & Power, 2004). In the current study, a partnership among the lead researcher, preschool teachers, and lunch monitors provided school staff with an opportunity to discuss the need for a nutrition-related intervention and to offer input regarding the development and implementation of school-based nutrition education components. This process facilitated enthusiasm for the program. Additionally, it allowed for discussions regarding the amount of time, effort, and resources required to implement components of the intervention, which are all factors found to be related to intervention acceptability (Witt & Elliott, 1985). It is likely that the classroom and lunchroom components were acceptable to teachers and lunch monitors because they believed the goals of the program were important for their preschool students, program materials were provided at no cost, and school staff self-selected program activities requiring little of their time and effort to implement. These findings are consistent with
prior research that examined teachers’ and lunch monitors’ acceptability of a similar intervention package (Hoffman et al., 2010; Hoffman, 2008). Students were also positive about each of the program’s components. Student feedback indicating that the program was acceptable from their perspective is important given the Center for Disease Control and Prevention’s (1996) recommendation that school-based nutrition education programs should be engaging and fun for students. Caregivers reported that the shared book reading activity was acceptable, which is similar to prior research on this type of family education approach (Blom-Hoffman et al., 2008). These findings, in combination with treatment integrity data, are important for the sustainability and future directions of the program.

**Behavior change.** As hypothesized, students who participated in the intervention ate significantly more vegetables in the school lunch at post-test relative to pre-test. At the end of the one-month intervention, students in the experimental group ate 3.9 more grams of vegetables per day in the school lunch at post-test relative to pre-test. This finding is consistent with the magnitude of change observed for vegetable consumption in a similar study (Hoffman et al., 2010). Students consumed just enough additional vegetables during lunch to receive a sticker, which indicated that students were motivated to earn the reward and that the lunch stickers were a potent motivator for the 4- and 5-year-old students participating in the study.

In contrast, there was no change in consumption among students in the control group from pre-test to post-test. Unexpectedly, students in the waitlist control group consumed more vegetables during lunch at pre-test relative to students in the experimental group. Given that students who participated in the intervention increased
their consumption from pre-test to post-test, by the end of the intervention there was no
difference between the two groups. Although it is unclear why students in the control
group consumed more vegetables during lunch at pre-test, it is notable that these students
were served less food at lunch than students in the experimental group despite the same
food service delivery program. Notably, it was observed that some foods (i.e., cookies
and fruit) were withheld by teachers and lunch monitors due to the belief that students
were overfed in school. School staff also had concerns about the amount of waste that
would be produced if students were provided all of the food on the menu each day due to
their tendency to throw large amounts of uneaten food away. It is possible that having
fewer options on the lunch tray may have contributed to greater vegetable intake at pre-
test, as these students had fewer additional foods to consume.

Knowledge change. Surprisingly, the hypothesis that students would have
improved fruit and vegetable knowledge as a function of participating in the study was
not supported. Whereas many prior studies have demonstrated effectiveness in
increasing young children’s nutrition knowledge (Auld et al., 1999; Blom-Hoffman &
DuPaul, 2003; Blom-Hoffman et al., 2004; D’Agostino et al., 1999), the lack of
knowledge change in the present study may have been due to language issues, a
disconnect between materials used in the intervention and assessment, and/or the brevity
of the intervention.

First, 65% of the students in the experimental group were English Language
Learners, as compared with 30% in the control group. Most English language learners in
the experimental group were second-generation Vietnamese immigrants and Vietnamese
was the primary language spoken in the home. For many children, the study year was
their first formal year of schooling in English. As such, the lack of knowledge change in this study should be interpreted with caution and may be more related to the language that the assessment was conducted in than the inability of the intervention to increase students’ awareness about the foods served in their school lunch. Prior research (Collier, 1995) has shown that non-native English speakers with no prior schooling may take 7-10 years to reach age and grade-level norms of their native English-speaking peers. In the future, knowledge assessments should be conducted in English as well as children’s native language to assess acquisition of nutrition content pre- and post-intervention. Knowledge assessments that were conducted in both English and Vietnamese would have more accurately estimated any change in student knowledge as a function of the program.

A second factor that may have contributed to a lack of knowledge change in the present study is the disparity between the manner of instruction and assessment. Daily nutrition education lessons included a tutorial in which students were taught to associate food names with pictures of fruit and vegetable cartoon characters that corresponded with the foods being served that day. In contrast, the assessment tool developed to measure knowledge change consisted of photographs of school lunches. It is possible that students were unable to generalize the symbolic, fruit and vegetable characters to the actual foods served in the cafeteria as depicted in the assessment tool. Awareness that altering an object's appearance does not change its basic properties generally occurs between 2-7 years of age (Piaget, 1929). It is possible that the 4- and 5-year old children in this study were unable to make these connections given their evolving cognitive development. Based on these findings, it is recommended that studies, particularly those
with young children, match instruction and assessment to better evaluate acquisition of nutrition knowledge.

It is also possible that the relatively short duration of the intervention was responsible for the lack of knowledge change. Another evaluation of a nutrition education program for preschool children that was implemented for 45 minutes per week for 30 weeks found marked improvements in children’s knowledge (D’Agostino et al, 1999). The nutrition education classes also employed a variety of teaching methods (e.g., large and small-group teacher-directed lessons, student-directed exploration centers, games, crafts, songs, and role plays). It is unclear how long interventions need to be implemented to impact knowledge change. Based on our findings and the unsustainable effects of the brief Girl Scout study (Cullen, 1997), intervention duration should probably exceed 4 weeks; however, interventions may require fewer than 30 weeks in order to impact knowledge change. In a systematic review of the fruit and vegetable promotion literature, Knai et al. (2006) found that many school-based fruit and vegetable promotion programs were implemented for two school years. Identifying the dosage of intervention required to yield enduring changes in children’s knowledge and behavior is an important question for future investigation.

**Study Limitations and Strengths**

This study includes several limitations related to the sample. First, only two schools participated in the program evaluation. Although it was decided that implementing the program at one school and having a second school serve, as the comparison group would be sufficient for the purpose of this preliminary investigation, this limits the ability to generalize findings of the outcome evaluation.
A second limitation was related to the non-equivalence between the two schools across important demographic variables. The two participating schools were from the same school district, matched on grade, type of school food service, and percent of children eligible for free or reduced price. Matching schools on other factors was difficult given that only a few schools in the district had preschool classrooms and only a portion of these schools utilized the satellite food service provider. It was important to restrict participating schools to the satellite food service provider to ensure equivalence across the types of foods served at the two schools. Given these parameters and the need for school principals to allow the study to take place at their school, it was not possible to match schools on important other variables such as student race/ethnicity and language spoken at home. Also contributing to the non-equivalence of groups were disparities in experimental and control group size. Participation rates were somewhat lower (60% - experimental group; 43% - control group) than the average participation rates (65.5%) found in school-based intervention and prevention studies that use active parental consent and report participation rates; however, these rates were comparable to that found by Hoffman et al. (2010), who conducted a similar study in the same school district. As a result of the small number of participating schools and the participation rate in this study, the total sample size was small. It is recommended that future school-based investigations employ multiple recruitment procedures to communicate with families about the study and to try to boost consent rates (Blom-Hoffman et al., 2009).

A third limitation was related to the program’s length of implementation. The intervention was implemented for only four weeks, which is far shorter than the evaluation of published fruit and vegetable promotion programs (Knai, 2006). It is
unlikely that knowledge or enduring behavior change can occur in this short time span. Future investigations should focus on the required dosage of interventions to yield sufficient knowledge and enduring behavior change. These evaluations should include a delayed follow-up evaluation period, wherein data are collected after the intervention has been withdrawn for a period of time.

A fourth limitation was related to the modes of instruction included in the classroom component. There were pronounced differences in implementation integrity across the four classroom activities, which suggested that technological limitations as well as set up time and effort might have contributed to teachers’ use of a few self-selected classroom activities. Future investigations should carefully design the classroom component with fewer than four activities to be implemented by the classroom teacher given the many demands placed on them. It is recommended that regular meetings with school staff are held to discuss difficulties with implementation although scheduling regular meetings can be difficult given the school schedule.

A fifth limitation was related to the data analyses conducted. Vegetable consumption data violated assumptions of normality and homogeneity of variance. Therefore, vegetable consumption data were unable to be analyzed using parametric statistics and non-parametric techniques, which have less power (Field, 2009), were used. Although a larger sample may prevent violations and thus allow for the use of parametric statistics, the data may continue to be positively skewed because students tend to eat small amounts of vegetables.

A sixth limitation was that students’ eating behavior outside of the school lunch was not evaluated. As a result, the extent to which vegetable consumption was affected
at home remains unknown. Although caregivers reported that the family books were enjoyable and informative, prior literature suggests that knowledge in isolation does not tend to produce behavior change (Blom-Hoffman & DuPaul, 2003). Because the program did not change home vegetable availability/accessibility, it is unlikely that children’s consumption of these foods changed; however, these data would be helpful for planning future programming.

A seventh limitation was related to the lead researcher’s intermittent presence in the classroom and lunchroom to conduct unannounced treatment integrity checks, which may have resulted in inflated intervention acceptability scores and treatment integrity data. Concerns about social desirability inflating teachers’ acceptability ratings are offset to some degree by the fact that teachers completed acceptability questionnaires anonymously. Similarly, teachers and lunch monitors may have increased the extent to which they implemented program components due to the researcher’s presence; however, lower than expected treatment integrity data for some classroom components indicated that teachers’ behavior did not likely change as a reaction to the researchers’ presence.

These limitations are offset by several strengths. This study involved a theory-based approach for impacting preschool children’s vegetable consumption and nutrition knowledge. The multi-component vegetable promotion intervention was developed using participatory action research (Nastasi et al., 2000) and the guidelines put forth by the Centers for Disease Control and Prevention (1996) and the American Dietetic Association (2006). Additionally, the program included many important components for effective fruit and vegetable promotion programs identified in the literature (Knai, 2006) including (a) focus on fruit and vegetables rather than on nutrition in general, (b) active
engagement in nutrition education activities, (c) social modeling by peers and symbolic role models, (d) encouragement by lunch staff to eat F&V, and (e) active involvement by families. The program was implemented in the context of a public school system with a healthy eating policy, which is another aspect of effective fruit and vegetable promotion programs (Knai, 2006). Other important strengths of this study involved measuring changes children’s eating behaviors using highly accurate, objective plate waste methods and utilizing an innovative measure (i.e., play) of nutrition knowledge.

Efforts were made to promote institutionalization of the program. For example, it was implemented within the existing infrastructure of the preschool, using school employees rather than specially trained interventionists to deliver program components. Additionally, program acceptability and treatment integrity were assessed. This study investigated the extent to which school partners perceived the importance of program goals and outcomes, the extent to which they believed the intervention was appropriate and/or enjoyable, and the opportunity to report any negative program side effects, of which there were none. Despite extensive attention to implementation integrity and acceptability in the school psychology literature (Martens & Witt, 1982; Power et al., 2005; Witt & Elliott, 1985), studies in the public health literature routinely do not report on program acceptability and implementation fidelity. The acceptability of program components was important to formally assess to allow for programmatic alterations that will more likely promote institutionalization of nutrition education efforts. The fidelity with which program components were implemented as designed was also important to formally assess to interpret outcomes.
Directions for Future Research

Given the dearth of healthy eating promotion interventions developed for children five years old and younger, there are numerous directions for future research. The data regarding the ability of the multi-component vegetable promotion program implemented in this study to impact children’s eating behavior and nutrition knowledge call for a more rigorous investigation to be conducted. In particular, the investigation should include a longer intervention duration (e.g., one school year), a larger sample size, inclusion of a delayed follow-up assessment, more closely matched groups, and attention to the language in which the knowledge assessment is administered.

Another study that would be interesting to conduct is to examine changes in eating behavior following the implementation of an interdependent group contingency (Skinner, Skinner, & Sterling-Turner, 2002). Although this method of reinforcement was considered in the current study, it was not appealing to the participating teachers due to feasibility issues. In the future, it would be important to design the program with fewer classroom activities, which would reduce the burden for classroom teachers. Included in the redesigned program would be (a) the “Caught Eating Vegetables” lunchroom component in which students are provided praise and a sticker contingent on consuming one bite of the vegetable served, (b) an interdependent contingency based on the entire class’ ability to meet a predetermined criterion (Skinner, Skinner, & Sterling-Turner, 2002) with regard to the number of lunch stickers obtained, (c) and the classroom component in which students learn the “Fruit and Vegetable of the Day.” Interdependent group contingencies have been beneficial in classrooms because students are likely to encourage one another to engage in the target behavior such as eating vegetables in the
school lunch. The Food Dudes program (Horne, Lowe, Fleming, & Downey, 1995; Horne, Tapper, Lowe, Hardman, Jackson, & Woolner, 2004; Lowe, Horne, Tapper, Bowdery, & Egerton, 2004; Tapper, Horne, Lowe, & Fergus, 2003; Woolner, 2000) utilized an interdependent group contingency that was initially effective for helping students consume more healthy foods in the school lunch. Popkin and Skinner (2003) demonstrated that randomly selecting the criterion contributed to behavior change. Last, teachers should obtain students’ suggestions for rewards to ensure that they are highly potent and motivating for students.

A third, very relevant future study is to examine whether serving fewer types of foods at lunch increases fruit and vegetable intake. For example, students in the experimental school were served calorie dense snacks (e.g., cookies and tortilla chips) as part of the National School Lunch Program. In contrast, students in the control school who consumed significantly more vegetables per day were not given the snacks. Literature on competitive foods suggests that students will eat more fruits and vegetables if they do not have additional unhealthy options (Cullen, 2004; Kubik, 2003). Currently, however, there are no data on whether the composition of the served lunch as part of the National School Lunch Program affects fruit and vegetable intake during lunch. If serving fewer unhealthy foods at lunch is found to increase students’ consumption of healthier foods, such as fruit and vegetables, school districts could save a substantial amount of money and students would benefit from adopting healthier eating behaviors at a young age. Of course, the menus would need to be carefully constructed to ensure children are being provided with adequate calories (i.e., 1/3 of the daily recommended calories) in the school meals that are consistent with federal guidelines (U.S. Department
of Agriculture, 1995).

Another innovative future study would be to further examine preschool children’s play with fruit and vegetable toys as a method of evaluating knowledge change. There is a dearth of programs in this area that utilize fruit and vegetable toys as a method of engaging students in the material and for assessing their knowledge. Students in the current study made very few fruit and vegetable verbalizations throughout the program’s implementation; however, they included the fruit and vegetable toys in their play. As a result, it would be interesting to assess their play using methods that capture both fruit and vegetable verbalizations and non-verbal play behaviors. For example, in addition to tracking fruit and vegetable verbalizations, it would be informative to also track changes in non-verbal play such as which foods are used during play, how they are used (i.e., cooked, served to others, etc.).

**Conclusions**

Childhood obesity is a growing problem for preschool-aged children, particularly for children living in poverty and for certain racial and ethnic minority groups (Anderson & Whitaker, 2009; Troiano & Flegal, 1998; Wang & Zhang, 2006; Winkleby et al., 2003). While policies at the national and state level have been beneficial for helping to combat this very complex epidemic in schools, much work remains. One of the contributing factors to childhood obesity is related to children’s insufficient consumption of vegetables (Centers for Disease Control and Prevention, 2007). The present outcome evaluation represented one of the first efforts that evaluated a vegetable promotion program that was designed specifically for 4- and 5-year-old children.
This study contributes to the literature base by describing the development, implementation, and evaluation of a school-based vegetable promotion program for preschool students that was implemented within the school’s existing infrastructure. It utilized an ecological approach as recommended by the American Dietetic Association (2006) as well as the important components of fruit and vegetable promotion programs identified in the literature (Knai, 2006). The program is one of the first for this age group that focused on strengthening the reinforcement contingencies for vegetable consumption in an effort to help young children eat more vegetables in the school, a setting where vegetables are served on a daily basis. Because nutrition education in isolation has not been effective in generating behavior change (Blom-Hoffman & DuPaul, 2003; Blom-Hoffman et al, 2008), behavior change strategies rooted in social learning theory (Bandura, 1977) and behavioral psychology (Skinner, Skinner, & Sterling-Turner, 2002) were integrated into program components and this preliminary investigation found that they were effective in helping young children to consume more vegetables during school lunch. Another unique aspect of this study was the use of play as a measure of children’s fruit and vegetable knowledge. This innovative method of knowledge assessment is worthy of further investigation.

This study represents one step toward determining which strategies are effective methods for helping preschool children develop healthier eating behaviors. However, there is a need to further explore methods for increasing young children’s vegetable consumption that will remain stable over time. Schools are an important arena for such efforts. It will be critical for researchers to continue to develop partnerships with school staff, families, and the community to send young children consistent messages about
nutrition that are effective in promoting healthy eating. Additionally, it is important to assess with each of these stakeholder groups which interventions are acceptable and feasible in order for them to endure and facilitate lasting behavior change for children.
References


Centers for Disease Control and Prevention. (2007). National Center for Health

Hyattsville, MD.


Fitzgibbon, M. L., Stolley, M. R., Schiffer, L., VanHorn, L., KauferChristoffel, K., &


Kennedy, K. (2010). Let’s Move! AAP joins White House anti-obesity initiative to


Monasta, L., Batty, G. D., Macaluso, A., Ronfani, L., Lutje, Bavcar, A., van Lenthe, F. J.,


Neumark-Sztainer, D., Story, M., Resnick, M. D., & Blum, R. (1996). Correlates of
inadequate fruit and vegetable consumption among adolescents. *Preventive Medicine, 25, 497-505.*


Perry, C. L., Bishop, D., Taylor, G., Davis, M., Story, M., & Gray, C. et al. (2004). A
randomized school trial of environmental strategies to encourage fruit and vegetable consumption among children. *Health Education and Behavior, 31*, 65-76.


Appendix A

Sample Lunch Stickers
Appendix B

Fruits & Veggies More Matters Book

Northeastern University
2010

By: Jessica Hoffman, Ph.D.
Revised By: Kaila Wilcox, M.S.
Dear Parents,

Your child is learning about the importance of eating fruits and vegetables in school. Please read this book together with your child, and sign the last page when you are done.

Remember, you and your family should try to eat at least 5 servings of fruit and vegetables each day. To receive a customized food plan for you and your family based on your individual characteristics, go to MyPyramid.gov.

Thank you and enjoy!
Color Me!

When you are finished reading this book, please bring it back to your teacher so your teacher knows you read it.
Hi, I’m Choosy. My fruit and vegetable friends and I want to tell you all about how important it is to eat fruits and vegetables every day.
Parents, please sign on the line below so your child’s teacher knows that you read this book with your child.

Child’s Name: ____________________________

Parent’s Signature: _______________________

Parents, please circle the responses below to let us know what you thought of this book:

1. How much did you enjoy reading this book with your child?
   a. a lot
   b. a little
   c. not at all

2. How much did you learn about eating more fruits and vegetables from this book?
   a. a lot
   b. a little
   c. nothing at all

Kids, please circle the responses below to let us know what you thought of this book:

1. How much did you enjoy reading this book?
   a. a lot
   b. a little
   c. not at all

2. How much did you learn about eating more fruits and vegetables from this book?
   a. a lot
   b. a little
   c. nothing at all
Fruits & Veggies More Matters means that we should all eat MORE fruits and vegetables, at least 5 servings every day.

What is your favorite vegetable?

Draw it here:
What is your favorite fruit?

Draw it here:

Be Choosy Be Healthy! 5 is an important number to remember when eating fruits and vegetables.

Chester & Chelsea Cherries

Kevin Kiwi

Gus Grapes

Stan & Sarah Strawberries

Amber Orange
There are lots of different ways you can eat MORE fruits & veggies every day.

When you go to the store, look for this sign. You can find this on bags of salad and on other fruits and vegetables. This sign tells you to eat more fruits and vegetables, at least 5 servings each day.
You can eat a salad or broccoli at dinner.

You can drink a glass of juice or eat a banana for breakfast.
You can eat an apple and carrots for lunch.

You can eat raisins or grapes for a snack after school.
Crave Your Colors!

Northeastern University
2010

By: Jessica Hoffman, Ph.D.
Revised By: Kaila Wilcox, M.S.
Dear Parents,

Your child is learning about the importance of eating fruits and vegetables in school. Please read this book together with your child, and sign the last page when you are done.

Remember, you and your family should try to eat at least 5 servings of fruit and vegetables each day. To receive a customized food plan for you and your family based on your individual characteristics, go to MyPyramid.gov.

Thank you and enjoy!
When you are finished reading this book, please bring it back to your teacher so your teacher knows you read it.
To be healthy it is important to eat at least 5 servings of fruits and vegetables every day. Did you know that fruits and vegetables come in lots of different colors? It is important to eat different colored fruits and vegetables each day. Try to eat at least one fruit and vegetable from each color group every day.

Parents, please sign on the line below so your child's teacher knows that you read this book with your child. Please tear out this signed page and return it to your child's teacher.

Child's Name:

Parent's Signature:

Parents, please circle the responses below to let us know what you thought of this book:

1. How much did you enjoy reading this book with your child?
   a. a lot
   b. a little
   c. not at all

2. How much did you learn about eating different colored fruits and vegetables from this book?
   a. a lot
   b. a little
   c. nothing at all

Kids, please circle the responses below to let us know what you thought of this book:

1. How much did you enjoy reading this book?
   a. a lot
   b. a little
   c. not at all

2. How much did you learn about eating different colored fruits and vegetables from this book?
   a. a lot
   b. a little
   c. nothing at all
Some fruits and vegetables are red. Tomatoes, peppers and radishes are examples of red vegetables. Apples, strawberries and raspberries are examples of red fruits. What is your favorite red fruit or vegetable?
Some fruits and vegetables are orange. Carrots, winter squash and sweet potatoes are examples of orange vegetables. Oranges, mangoes and cantaloupe are examples of orange fruits. What is your favorite orange fruit or vegetable?

Remember, to grow up strong and healthy, try to eat as many fruits and vegetables in as many colors as you can every day!
Some vegetables are white. Cauliflower, onions, and mushrooms are examples of white vegetables. What is your favorite white vegetable?

Some fruits and vegetables are yellow. Summer squash and yellow peppers are examples of yellow vegetables. Bananas and pineapples are examples of yellow fruits. What is your favorite yellow fruit or vegetable?

Draw it here:
Some fruits and vegetables are green. Lettuce, broccoli, and asparagus are examples of green vegetables. Kiwi, pears, and green grapes are examples of green fruits. What is your favorite green fruit or vegetable?

Some fruits and vegetables are blue or purple. Eggplant and red cabbage are examples of purple vegetables. Grapes, blueberries, and blackberries are examples of blue and purple fruits. What is your favorite purple fruit or vegetable?

Draw it here:
Appendix D
Lunchtime Observation Data Collection Sheet

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<tr>
<th></th>
<th>Day:</th>
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</thead>
<tbody>
<tr>
<td>Date:</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>School:</td>
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<td></td>
<td></td>
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<tr>
<td>Researcher Name:</td>
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</table>

<table>
<thead>
<tr>
<th>Food 1</th>
<th>Food 2</th>
<th>Food 3</th>
<th>Food 4</th>
<th>Food 5</th>
<th>Food 6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Given Away</td>
<td>Received from another student</td>
<td>Thrown Away or Fall on Floor</td>
<td>Brought from home</td>
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<tr>
<td>Child’s Name</td>
<td></td>
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Appendix E

Plate Waste Observation Record Sheet

<table>
<thead>
<tr>
<th>Participant #</th>
<th>Child’s Name</th>
<th>Day: 1</th>
<th>Day: 2</th>
<th>Day: 3</th>
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Appendix F

Acceptability Measure – Children

Participant# ____________

Date: ____________

Please read each item using the picture book and ask each student to point to the faces that best describe his/her feelings about the program. Please use the following scale when rating each item.

<table>
<thead>
<tr>
<th>Item</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Did you ever receive stickers at lunch?</td>
<td>Yes/No</td>
</tr>
<tr>
<td>2. What did you have to do to earn a sticker?</td>
<td></td>
</tr>
<tr>
<td>3. How much did you like getting the stickers at lunch?</td>
<td></td>
</tr>
<tr>
<td>4. Did you ever see the poster in the classroom with the Fruit and Vegetable of the day?</td>
<td>Yes/No</td>
</tr>
<tr>
<td>5. How much did you like the poster?</td>
<td></td>
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<td>6. Did you ever hear the songs that Choosy sings in your classroom?</td>
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<td>7. How much did you like the songs?</td>
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<td>8. Did you ever play with the fruit and vegetable toys in your classroom?</td>
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<td>9. How much did you like the toys?</td>
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Appendix G

Acceptability Measure - Teachers

School: ______________________                          Date:__________________

Please circle the faces that best describe your feelings about the nutrition education program. Please use the following scale when rating each item.

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<tr>
<th>Strongly Disagree</th>
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</table>

1. Teaching students the “Fruit and Vegetable of the Day” is an acceptable way to encourage students to eat more fruits and vegetables.

2. The classroom “Fruit and Vegetable of the Day” board is an acceptable way to encourage students to eat more fruits and vegetables.

3. The Choosy Kids CD and DVD are acceptable ways to encourage students to eat more fruits and vegetables.

4. The fruit and vegetable stickers are an acceptable way to encourage students to eat more fruits and vegetables during school lunch.

5. The take home books are an acceptable way to encourage students to eat more fruits and vegetables.

6. These activities (i.e., F&V of Day, DVD, CD, toys, lunchtime stickers, and take home books) should prove effective in improving students’ knowledge.

7. These activities (i.e., F&V of Day, DVD, CD, toys, lunchtime stickers, and take home books) should prove effective in improving students’ eating behaviors.

8. I would suggest that other teachers use these program activities (i.e., F&V of Day, DVD, CD, toys, lunchtime stickers, and take home books) with their students to encourage them to eat more fruits and vegetables.

9. Students’ eating behavior is poor enough to warrant use of these activities.
10. I am willing to use these activities in my classroom in the future. ☺☺☺ ☺☺ ☺ ☺☺☺

11. The fruit and vegetable promotion activities would be appropriate for most K-1 students. ☺☺☺ ☺☺ ☺ ☺☺☺

12. The fruit and vegetable promotion program was not disruptive to the classroom. ☺☺☺ ☺☺ ☺ ☺☺lovak

13. The fruit and vegetable promotion program was not difficult to implement in a classroom with 15-20 students. ☺☺☺ ☺☺ ☺ ☺☺☺

14. Teachers are likely to use the Choosy Kids CD and DVD because they require little technical skill. ☺☺☺ ☺☺ ☺ ☺☺☺

15. Teachers are likely to use the “Fruit and Vegetable of the Day” board because it takes little training to implement. ☺☺☺ ☺☺ ☺ ☺☺lovak

16. The fruit and vegetable promotion components did not take away too much time from important educational priorities in my classroom. ☺☺☺ ☺☺ ☺ ☺☺lovak

17. Overall, the program was beneficial for the children in my classroom. ☺☺lovak ☺☺☺ ☺☺lovak

18. Overall, the students in my classroom enjoyed participating in the program. ☺☺lovak ☺☺☺ ☺☺lovak

19. The program made me more aware of my own fruit and vegetable consumption. ☺☺lovak ☺☺☺ ☺☺lovak

20. The program helped me eat more fruits and vegetables. ☺☺lovak ☺☺☺ ☺ Slovak

Comments:
Appendix H

Acceptability Measure - Lunch Monitors

Please circle the faces that best describe your feelings about giving students stickers to help them eat more fruits and vegetables in the school lunch. Please use the following scale when rating each item.

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Disagree</th>
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<th>Agree</th>
<th>Strongly Agree</th>
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1. Giving stickers to students when they eat fruit and vegetables during lunch is a good way to help them eat more fruit and vegetables.

2. Most students need help eating fruit and vegetables in school.

3. Giving children stickers for eating their fruit and vegetables did *not* cause problems at lunch (if it did, please explain on the back of this page).

4. I want to continue to give students stickers for eating their fruits and vegetables at lunch next year.

5. Giving students stickers during lunchtime did *not* take too much time.

6. I liked giving kids stickers during lunchtime.

7. It was *not* difficult to remember to give students stickers at lunch.

8. It was *not* difficult to give students stickers and to complete my other responsibilities.

9. I think that Lunch Monitors at other schools should give students stickers when they eat their fruits and vegetables at lunch.

10. Giving students stickers helped them eat more fruits and vegetables at lunch.
Appendix I

Lunchtime Treatment Integrity Log

<table>
<thead>
<tr>
<th>Date</th>
<th>School</th>
<th>Grade &amp; Classroom</th>
<th>Did lunch monitors distribute lunch stickers contingent on V consumption?</th>
<th>Did lunch monitors provide verbal praise contingent on V consumption?</th>
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Appendix J

Classroom Treatment Integrity Log

Dear TEACHER’S NAME,

Thank you for your participation in this nutrition education program to help students in K-1 eat more fruits and vegetables in the school lunch. It would be helpful if you are able to keep track of the nutrition education activities completed in the classroom.

<table>
<thead>
<tr>
<th>Date</th>
<th>Fruit and Vegetable of the Day</th>
<th>Did you use the F/V of Day Board? (Yes/No)</th>
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</table>
Dear K-1 Teachers,

Thank you for your participation in this nutrition education program to help students eat more fruits and vegetables in the school lunch. The following would be helpful for tracking how much students enjoyed program components.

**Fruit and Vegetable of the Day Board**

- How often did you use the fruit and vegetable of the day board?
- How much did your students seem to enjoy the fruit and vegetable of the day board?

  Not at all  Not much  A little  A lot

**Fruit and Vegetable Toys**

- How often did students play with the fruit and vegetable toys?
- How much did your students seem to enjoy them?

  Not at all  Not much  A little  A lot

**Meet Choosy DVD**

- How often did students view the Meet Choosy DVD?
- How much did your students seem to enjoy it?

  Not at all  Not much  A little  A lot

**Choosy CD**

- How often did students hear the Choosy CD?
- How much did your students seem to enjoy it?

  Not at all  Not much  A little  A lot
Appendix K

Informed Consent -VPP

Investigator Name: Kaila Wilcox, M.S.
Title of Project: Promoting Vegetable Consumption among 4-Year-Old School Children: Evaluation of a Nutrition Education Program

Consent to Participate in a Research Study
I am inviting you and your child to take part in a research study. This letter will tell you about the study. You and your child do not have to participate if you do not want to. After you read this letter, please sign the last page and let me know if you and your child want to participate or not. Please return the signed page to your child’s teacher. You can keep the rest of the letter for yourself.

*Why are my child and I being asked to take part in this research study?*
I am asking you and your child to be in this study because he/she is in K-1 in the Boston Public Schools. Your child’s school has agreed to evaluate a nutrition program to help children learn more about fruit and vegetables and eat more vegetables in the school lunch.

*Why are you doing this research study?*
The purpose of this research is to find out whether the nutrition education program helps students learn about fruit and vegetables and to eat more vegetables in the school lunch.

*What will you and your child be asked to do?*

**Your participation** - You will receive 2 children’s books that I will ask you to read with your child. This will take about 20 minutes.

**Your child’s participation** - I will:
1. Observe what your child eats in his/her school lunch on 6 separate days.
2. Ask your child questions about fruit and vegetables (10 minutes).
3. Weigh and measure your child (5 minutes).

*Where will this take place?*
The entire study will take place at your child’s school. Your child will be asked all questions individually without other children or teachers able to hear his/her answers. Your child will be weighed and measured in the privacy of the school nurse’s office with his/her shoes off.

*Will there be any risk or discomfort to me or my child?*
It is not expected that you or your child will be at any risk in this study. There is a small possibility that your child may feel uncomfortable about being weighed and measured in the school nurse’s office. To address this possible concern, your child will be weighed
and measured in privacy. Also, the school nurse will be available to discuss any concerns your child has about being weighed and measured.

*Will my child benefit by being in this research?*
Your child may have: increased nutrition knowledge; improved fruit and vegetable eating behaviors; and early development of lifelong behaviors to prevent obesity.

*Who will see the information about me?*
Only the researchers working on this study will see the information about your child. To keep the information about your child confidential, your child will be assigned a number. All of the information we collect about your child will be coded with that number instead of your child’s name. We will keep the information in a locked filing cabinet. The information will be destroyed after 3 years.

In rare instances, authorized people may request to see research information about you and other people in this study. This is done only to be sure that the research is done properly. We would only permit people who are authorized by organizations such as Northeastern University to see this information.

*Can I stop our participation in this study?*
Yes, you and your child’s participation in this research are completely voluntary. You and your child do not have to participate if you do not want to. Even if you and your child begin the study, you may stop at any time.

*Who can I contact if I have questions or problems?*
If you have any questions about this study, you can contact Kaila Wilcox, M.S., doctoral student at Northeastern University at (401)269-9918, or Dr. Jessica Hoffman, Associate Professor of School Psychology at Northeastern University at (617)373-5257.

*Who can I contact about our rights as a participant?*
If you have any questions about your child’s rights as a participant, you may contact Nan Regina, Division of Research Integrity, 960 Renaissance Park, Northeastern University, Boston, MA 02115. Telephone: (617) 373-7570. You may call anonymously if you wish.

**Will my child or I be paid for our participation?**
No, you will not be paid for your participation.

**Will it cost me anything to participate?**
No, your participation involves no cost to you.

---

Thank you for reading this letter!
You may keep this letter for yourself.

**Please sign the next page and return that page to your child’s teacher.**
Please return this page to your child’s teacher. Thank you!!

Please print your child’s name here:
________________________________________

Please print the name of your child’s school here:
________________________________________

Please print the name of your child’s teacher here:
________________________________________

_____ I agree that my child and I will take part in this research study.

_____ I do not want my child and me to take part in this study.

_______________________________________
Signature of parent/guardian agreeing to take part  ________

_______ Date

________________________________________
Printed name of person above
Appendix L

Informed Consent – Knowledge Measure Development

Dear Parents/Guardians:

A doctoral student from Northeastern University, Kaila Wilcox, will work with our students to develop a knowledge assessment to measure student knowledge of fruit and vegetables. Ms. Wilcox is requesting your permission to ask your child questions about fruits and vegetables in school. The questions will be asked two times, two weeks apart. Your child’s name will not be written down on the questionnaire. Should you have any questions about this please do not hesitate to contact Ms. Wilcox at 401-269-9918.

If you agree to allow your child to participate in the project you can withdraw his/her participation at any time. This project has been approved by the Institutional Review Board at Northeastern University. If you have any questions about your child’s rights as a participant, you may contact Human Subject Research Protection, Division of Research Integrity, 413 Lake Hall, Northeastern University Boston, MA 02115 tel. 617-373-7570. You may call anonymously if you wish.

If you agree to have your child complete the questionnaires about fruits and vegetables, please sign the next page and return it to your child’s teacher.

Thank you for reading this letter!
You may keep this letter for yourself. 
Please sign the next page and return that page to your child’s teacher.
Please return this page to your child’s teacher. Thank you!!

Please print your child’s name here:
__________________________________________

Please print the name of your child’s school here:
__________________________________________

Please print the name of your child’s teacher here:
__________________________________________

_____ I agree that my child and I will take part in this research study.

_____ I do not want my child and me to take part in this study.

_______________________________________    _______________
Signature of parent/guardian agreeing to take part    Date

__________________________________________
Printed name of person above
Appendix M

Plate Waste Data Collection Training Materials

1. Giving students name tag necklaces before lunch.
   - Students will be wearing name tags during lunchtime
   - To reach all students in a timely manner, we will give them to all students in the classroom before lunch.
   - Names written in green = student IS IN the study (TO BE OBSERVED)
   - Names written in red = student is NOT in the study (NOT OBSERVED)
   - “We are interested in seeing what kids at your school eat in the school lunch. So, when you are finished eating, don’t throw anything away. When you are done eating put your nametag on your lunch tray to let us know you are done. Then we will take your tray for you. Don’t throw anything away!”

2. Observing students eating lunch.
   - Stand in a location where you can have a clear view of the children you are observing, yet not too close to the children. It is very important that you minimize your interactions with the children.
   - Each observer will watch children at 1 table for the entire lunch period
   - Important to stay alert during observation to record information (try not to talk to each other during this time unless absolutely necessary)
   - As soon as the children sit at your table, write down the children’s names that are written in green. Record the foods that are on the try by placing a check mark in the corresponding box on the observation form.
   - Other behaviors to look for include trades, foods that fall on the floor or are thrown away, and additional foods that are brought from home. This information is recorded on the form as well. A trade is defined as giving or receiving food from another child.
   - GUARD THE GARBAGE CANS! We will tell the lunch mothers to help with this too, but it is very easy for data to be thrown away when no one is looking.
   - When children are finished eating, they should place their name tag on their tray. This is a signal that you can collect their lunches.

3. Collecting students’ lunch
   - When you see a child’s name tag on the plate or a child looks like he/she is about to throw away the lunch, intercept the lunch and move it to the pre-determined table.
   - You may need to ask a child if he/she is done eating.

4. Weighing/measuring lunch components
   - Once the trays are all on the weighing table, we will use the food scales and the graduated cylinder to assess the plate waste.
   - Before weighing the children’s trays we will weigh the sample lunches to get an average weight for each food component.
   - Once data from a try are gathered then we can throw the plate away.
   - It is important that we clean up completely in the café.
Appendix N

Child Assent

Promoting Vegetable Consumption among 4-Year-Old Children: Evaluation of a School-Based Nutrition Education Program

Script for Obtaining Student Assent

Hi, how are you? (Listen to responses, respond appropriately). My name is X, and today I’m asking you to help me with a research study. We are trying to learn more about what kids in your school eat at lunch. Your mom/dad have already said that it is OK for you to be a part in this project, but you can decide whether or not you want to. Here is what it involves:

- I am going to look at your lunch
- I will see how tall you are and how much you weigh
- I will be asking you questions about fruits and vegetables
- If you want to stop at any time, just say so and we can stop.

OK. Do you have any questions? Are you interested in being a part of our study?

YES NO

Child’s Name ________________________________________________________________

School ________________________________________________________________

Teacher/Grade _____________________________________________________________

Date ________________________________________________________________

Researcher ______________________________________________________________

I certify that I provided the above information to this child, and that the child assented to participate in the project Promoting Vegetable Consumption among 4-Year-Old Children: Evaluation of a School-Based Nutrition Education Program.

Signature of Researcher ________________________________________________