


Winter 2017

# THE ASSOCIATIONS OF FARM-TO-SCHOOL PROGRAMS ON CHILDHOOD OBESITY IN SCHOOL BREAKFAST

Hannah Brzozowski  
brzozowskh@cwu.edu

Follow this and additional works at: <https://digitalcommons.cwu.edu/etd>

 Part of the [Education Commons](#), and the [Medicine and Health Sciences Commons](#)

---

## Recommended Citation

Brzozowski, Hannah, "THE ASSOCIATIONS OF FARM-TO-SCHOOL PROGRAMS ON CHILDHOOD OBESITY IN SCHOOL BREAKFAST" (2017). *All Master's Theses*. 626.  
<https://digitalcommons.cwu.edu/etd/626>

This Thesis is brought to you for free and open access by the Master's Theses at ScholarWorks@CWU. It has been accepted for inclusion in All Master's Theses by an authorized administrator of ScholarWorks@CWU. For more information, please contact [pingfu@cwu.edu](mailto:pingfu@cwu.edu).

THE ASSOCIATIONS OF FARM-TO-SCHOOL PROGRAMS ON CHILDHOOD  
OBESITY IN SCHOOL BREAKFAST

---

A Thesis  
Presented to  
The Graduate Faculty  
Central Washington University

---

In Partial Fulfillment  
of the Requirements for the Degree  
Master of Science  
Nutrition

---

by  
Hannah Brzozowski  
February 2017

CENTRAL WASHINGTON UNIVERSITY  
Graduate Studies

We hereby approve the thesis of

Hannah Brzozowski

Candidate for the degree of Master of Science

APPROVED FOR THE GRADUATE FACULTY

\_\_\_\_\_

\_\_\_\_\_  
Dr. Nicole Stendell-Hollis, Committee Chair

\_\_\_\_\_

\_\_\_\_\_  
Professor Dana Ogan

\_\_\_\_\_

\_\_\_\_\_  
Dr. Timothy Englund

\_\_\_\_\_

\_\_\_\_\_  
Dean of Graduate Studies

ABSTRACT  
THE ASSOCIATIONS OF FARM-TO-SCHOOL PROGRAMS ON CHILDHOOD  
OBESITY IN SCHOOL BREAKFAST

By  
Hannah Brzozowski  
February 2017

Farm to School (F2S) programs claim to increase fruit/vegetable consumption and promote healthy, lifelong food/beverage choices. Both of which are identified strategies in the prevention of childhood obesity. Long-term effects of F2S programs are largely unexplored. This cross-sectional study matched ten schools, five with F2S, and five with a traditional National School Breakfast Program (NSBP). Third- and fourth-grade students (n=1031) were recruited for study participation to assess the effects of regular breakfast consumption and participation in F2S programs on body mass index (BMI). Demographic data, anthropometric data, and frequency of breakfast participation were collected. Additionally, BMI and frequency of breakfast consumption over a ten-day period, excluding non-school days, was stratified by frequent eaters (7-10), occasional eaters (3-6), and skippers (0-2) were collected. Results showed no significant difference in BMI-for-age between F2S and traditional NSBP. This data suggests that in this population regular breakfast consumption was not correlated with BMI or BMI-for-age.

## TABLE OF CONTENTS

	Chapter Page
I INTRODUCTION .....	1
II LITERATURE REVIEW .....	3
Complications Associated with Childhood Obesity.....	4
Recommendations in the Prevention and Treatment of Childhood Obesity.....	5
The Benefits of Breakfast .....	6
Habitual Breakfast Consumption and Correlation with Body Composition....	8
Detrimental Effects of Habitual Breakfast Skipping .....	11
The National School Lunch and Breakfast Program .....	14
Farm to School.....	15
Purpose of Current Study.....	17
III JOURNAL ARTICLE .....	23
Abstract.....	25
Introduction.....	27
Methodology.....	29
Figure 1- Study Design.....	30
Table 1- Sample Demographic Information.....	31
Results and Discussion.....	33
Table 2- Mean BMI-for-Age compared by grade, gender, breakfast frequency, and eligibility .....	35
Conclusion and Application.....	39
IV REFERENCES .....	44
V COMPREHENSIVE THESIS REFERENCES .....	51
VI APPENDIXES .....	55

### CHAPTER I

#### INTRODUCTION

Childhood overweight and obesity continues to remain a persistent problem nationally as well as globally. Due to the numerous co-morbidities related to childhood obesity, such as diabetes, cardiovascular disease, stroke, and select cancers, among others,<sup>1-12</sup> many national coalitions have been developing and implementing strategies in an attempt to attenuate the epidemic. These strategies vary from public policy changes, marketing regulations, governmental zoning, and school-based interventions. School-based interventions are especially promising as millions of children attend public schools and consume the majority of their daily caloric intake within the academic setting.

The National School Lunch Program (NSLP) and National School Breakfast Program (NSBP) continue to be a common battleground in efforts to reduce rates of childhood obesity. In 2010 the Healthy, Hunger-Free Kids Act (HHFKA) required schools to shift towards more nutritious meals, offering more fruits, vegetables and whole grains, serving legumes, and limiting sugar sweetened beverages and serving sizes. The NSBP could have significant influence on childhood body mass index (BMI), considering the relationship of regular breakfast consumption on achieving and maintaining a healthy body weight. Other school-based interventions have been noted as potential strategies to reduce and prevent childhood obesity, such as the Farm to School (F2S) program. Which is a loosely defined initiative to implement inclusion of more local produce and foods in school meals, increase exposure to local food systems, and educate children on the importance of eating fresh minimally processed foods. As these initiatives mature and transform, it's becoming increasingly evident the need to understand how effective these interventions are and how they can be potentially improved upon.

## **CHAPTER II**

### **LITERATURE REVIEW**

## **Background**

Childhood obesity remains a significant public health concern in the United States with a substantial 17% of the population ages 2-19 classified as obese.<sup>1</sup> Between 1980 and 2010 obesity increased exponentially; in 2-5 year olds obesity doubled and for children 6-11, obesity tripled.<sup>1-2</sup> This increasing trend has slightly lessened with the percentage of obese children having minimally fluctuated around 17% from 2004 to 2014.<sup>1</sup> Although the rate of obesity has not significantly increased from 2003 to 2012, the percentage of children who are overweight or obese remains very high at 31.8% as of 2014.<sup>1</sup> The Academy of Nutrition and Dietetics (AND) declares that obesity in children and youth should remain a national public health priority, especially since research shows it may co-exist with food insecurity, poverty, and hunger.<sup>3</sup>

## **Complications Associated with Childhood Obesity**

Obese children suffer from an overall decreased quality of life (QOL), impacting emotional, social, and physical health.<sup>4</sup> They are more likely to experience weight stigma and body dissatisfaction.<sup>5</sup> and are not only more likely to be bullied, but ranked lowest as those with whom other children would like to be friends with,<sup>6</sup> further contributing to worsening emotional health. In fact, QOL is so reduced in obese children it's comparable to children diagnosed with cancer, as demonstrated by a QOL inventory generic core scale survey evaluating over 100 5-18 year olds.<sup>4</sup> These emotional and social obstacles transcend into the academic environment and performance. Children struggling with



obesity are more likely to suffer academically as well. According to a study by Geier et al., they miss more days of school, an average of 4.2 days per month, and have reduced academic performance,<sup>4,7-8</sup> likely as a result of increased absenteeism. This trend remains significant after adjusting for age, ethnicity, and gender.<sup>7</sup> In addition to these emotional and cognitive related complications, overweight and obese children suffer from physical and disease-related complications as well.

Physical implications related to overweight and obesity in children include increased risk of asthma, sleep apnea, earlier female puberty, as well as delayed male puberty.<sup>9</sup> These factors may further contribute to adverse social development and QOL as aforementioned. In addition to those risks, a well-respected team of researchers with The Bogalusa Heart Study found evidence that cholesterol, triglycerides, blood pressure, and BMI status as early as age nine can be used to predict adult atherosclerosis risk.<sup>10</sup> Children who suffer from obesity have higher risk and prevalence of hyperlipidemia, and abnormal glucose tolerance.<sup>6</sup> Consequences of this include increased risk of several chronic diseases, such as diabetes, cardiovascular disease, and stroke; as well as joint problems, fatty liver disease, and select cancers throughout child and adult life;<sup>9,11</sup> all diseases previously thought to be restricted to adults. In adolescents, the odds of being diagnosed with metabolic syndrome as an adult increased by 1.55 every half-unit increase in BMI z-score.<sup>12</sup> The consequences of childhood obesity are undeniable. The need for effective programs to prevent and treat childhood obesity is recognized and considered a public health priority on a national level among various organizations.

### **Recommendations in the Prevention and Treatment of Childhood Obesity**

The AND recognizes the national need of prevention and treatment of childhood

obesity and recommends a systematic approach starting with early child- and school-based interventions.<sup>13</sup> They note that although the leveling off of obesity prevalence in youth is favorable, the rates remain alarmingly high, as well as disproportionately so in regards to race and ethnicity. While the Institute of Medicine (IOM) recommends BMI screening in school settings, the AND recommends interventions that include a focus on food marketing practices, regulations, governmental zoning, and policy changes.<sup>13-14</sup> There are multiple national efforts to reduce childhood obesity. The Healthy People 2020 objectives also target childhood obesity, hoping to reduce the percentage of obese children and adolescents by 10%.<sup>15</sup> The Center for Disease Control's (CDC) Division of Nutrition, Physical Activity, and Obesity reports the following objectives: to improve dietary quality, promote healthy child development, increase physical activity, and decrease prevalence of obesity through prevention of weight gain and maintenance of healthy weight.<sup>16</sup> The IOM recently released their strategy to decrease childhood obesity by making physical activity an integral and routine part of life, creating food and beverage environments and ensuring accessible healthy food and beverage options, marketing healthy messages about activity and nutrition, and making schools a national focal point for obesity prevention.<sup>14</sup> For schools to be a national focal point for obesity prevention the IOM must work collaboratively with the NSLP and NSBP, which currently sustain a large percentage of the nation's youth in terms of daily energy and nutrition needs.<sup>17</sup> How the NSBP in particular may promote achievement and maintenance of a healthy body weight from a young age is the primary focus of this research.

### **The Benefits of Breakfast**

A large body of research exists evaluating breakfast consumption and its

protective association against obesity. Claims of improved cognitive performance, QOL, weight management, and reduced risk of cardiovascular disease and type 2 diabetes have been previously associated with regular, high-quality breakfast consumption.<sup>4,18-31</sup>

However, it should be noted that outside of the NSBP, the meal of breakfast is not rigidly defined which may skew or attenuate previous research findings; possibly explaining varying outcomes in regards to the protective effect of breakfast consumption. A recent review by O’Neil states there is a lack of science-based guidance on what is considered to be a nutrient dense “quality” breakfast or even on how “breakfast” is defined.<sup>32</sup>

Definitions have varied from time of day, frequency, place of consumption, activities occurring during consumption such as walking or reading, types of food groups, and energy consumed. Without a distinct and consistent definition of breakfast, gaps in the literature remain and few conclusions can be made. The proposed definition of O’Neil’s analysis is *“breakfast is the first meal of the day that breaks the fast after the longest period of sleep and is consumed within 2 to 3 hours of waking; it is comprised of food or beverage from at least one food group, and may be consumed at any location”*.<sup>32</sup>

Utilizing and implementing a standardized definition would allow for consistent inferences and conclusions to be made from the literature and would also align with the rigidity of school breakfast standards.

O’Neil’s review illustrated several trends regarding breakfast. Such as positive effects in breakfast habits in children with parents that modeled habitual breakfast consumption; but regardless of parental modeling, as children aged, breakfast consumption was reduced from 99% to 85% by age 13.<sup>33</sup> A national survey called What We Eat In America, which analyzed NHANES data from 2009-2010, made similar

conclusions and noted that breakfast consumption quality and quantity decreased with increasing age.<sup>34</sup> The researchers also saw that adolescents that reported being overweight or dissatisfied with their body were less likely to eat breakfast in hopes of weight loss or weight gain prevention.<sup>32,35-36</sup> Yet even with inconsistent definitions of breakfast, most studies, but not all, have shown that those who skip breakfast, including children and adolescents, are more likely to be overweight and obese and more likely to have a less healthful lifestyle.<sup>32,37-44</sup> This illustrates the lack of understanding regarding breakfast skipping and increased BMI and indicates a need for nutrition education regarding the importance of breakfast beginning at a young age.<sup>22,45</sup>

Other studies have inferred that perhaps the act of skipping breakfast is associated with other detrimental health habits, such as infrequent exercise, smoking, alcohol use, and caffeinated soda consumption<sup>43,46</sup> leading to potential confounding in relation to the proposed benefits of regular breakfast consumption. Breakfast skippers are more likely to be dissatisfied with their body, and are more likely to state lack of time and not being hungry in the morning as reasons for skipping breakfast.<sup>36</sup> It has been proposed that weight related concerns in children and teens may influence breakfast frequency, which in turn impacts dietary quality and appetite control, which then alters total energy intake adversely impacting BMI.<sup>43</sup>

### **Habitual breakfast consumption and correlation with body composition and other health-related behaviors**

Multiple studies have examined the effects of habitual breakfast, though as stated earlier, the lack of universal definition of breakfast creates ambiguity. A 2010 European systematic review of 16 different cross-sectional or cohort trials evaluated breakfast

consumption and body weight in children. Out of the studies, 13 showed that breakfast had a protective effect against becoming overweight or obese,<sup>30</sup> but of the 13, only three studies rigidly defined breakfast. Although few studies defined breakfast clearly, most studies specified criteria a subject must meet to be identified as a breakfast skipper; primarily measured by frequency of breakfast consumption. One review study of 382 male and 429 female Greek adolescents (mean age: 16.6 yrs; mean BMI: 23.10 kg/m<sup>2</sup>) tried to more rigidly define breakfast by dividing breakfast habits into 24 definitions, with definitions that ranged from average intake on day of survey to number of breakfast meals consumed in the last week.<sup>47</sup> The study concluded that the association between BMI and breakfast is dependent on the definition of breakfast; further contributing to the ambiguity around the benefits of regular breakfast consumption.

Another study evaluating male (n=4401) and female (n=4909) Greek and Finish teens (mean age: 16yo) assessed average eating behavior by categorizing breakfast habits into four groups based on normal eating behavior during the last calendar year: daily, 1-3 times per week; 1-3 times per month; and never/rarely. Interestingly, breakfast consumption was found to be inversely correlated with weight in both Greek and Finn male subjects but not females (P<0.001).<sup>48</sup> Yet in contrast to Veltsista's study, a 2005 study by Affenito et al., did find a significant inverse relationship between BMI and frequency of breakfast in nine to ten year old females (Affenito). As frequency of breakfast increased BMI was predicted to be lower  $x^2 [1] = 14.05$  (P<0.005).<sup>27</sup> Affenito concluded that girls who routinely eat breakfast have a reduced BMI compared with girls categorized as infrequent breakfast eaters, adding to the existing body of research supporting habitual breakfast consumption and more favorable body weight.

In addition to favorable body weight, positive health habits have been identified that correlate with habitual breakfast consumption, such as exercise patterns and performance.<sup>27,30</sup> Children who consumed breakfast performed significantly better in the standing long jump, 20-m sprint, and the shuttle run ( $P < 0.005$ ).<sup>49</sup> Consistent with other findings, children in this study who reported daily breakfast consumption also had a significantly lower BMI when compared to children who seldom or never did ( $16.7 \pm 2.2$  kg/m<sup>2</sup> versus  $18.2 \pm 3.0$  kg/m<sup>2</sup> and  $18.8 \pm 3.4$  kg/m<sup>2</sup>, respectively;  $P < 0.05$ ).<sup>49</sup> This finding also adds to the overall body of evidence of the benefits of breakfast consumption on body weight and other health aspects.

The true underlying mechanism linking reduced likelihood of obesity to regular breakfast consumption among children and adults is unclear. Szajewska and Ruszczyński suggest an overall healthier lifestyle comprised of habitual meals and regular activity, as well as a satisfactory daily nutrient profile, increased fiber consumption, and good blood glucose control may be responsible for the connection.<sup>30</sup> In agreement with this a study by Pereira et al., also concluded that healthy weight management was best achieved in those that habitually consumed a breakfast comprised of fiber, nutrient rich whole grains, and low-fat dairy products; all of which support appetite control and blood sugar attenuation throughout the day.<sup>23</sup> While Timlin et al., hypothesized that breakfast frequency was affected by weight-related concerns, overall dietary quality, and daily appetite control; all of which also effect body weight. Finally, Warren et al., hypothesized that caloric composition of lunch may be down regulated by glycemic values due to breakfast components and consumption suggesting that children may over indulge or make poor food decisions at lunch if breakfast is skipped or poorly composed.<sup>50</sup> This

finding is consistent with the observation of generally improved macro- and micronutrient intake in association with habitual breakfast consumption.<sup>22,24,44</sup> For example, breakfast skippers consume fewer daily grams of protein, and greater calories at lunch, dinner, and through frequent snacking than consistent breakfast consumers;<sup>24</sup> indicating breakfast skippers tend to have a poorer macro- and micronutrient distribution throughout the day as well as greater overall energy intake. A study by Deshmukh analyzing NHANES data correlated mean adequacy ratio (MAR) of vitamin A, E, C, B6, B12, thiamin, niacin, riboflavin, folate, phosphorus, magnesium, iron and zinc to self-reported breakfast habits of children aged 9-18 and found MAR was lowest for subjects that were categorized as breakfast skippers.<sup>22</sup> An additional study noted that days in which breakfast was consumed correlated with higher calcium and fiber intake in nine -ten year old girls.<sup>27</sup> Participants of the study consumed an average of 75.6 mg more calcium per day ( $\chi^2 = 81.29, P < 0.001$ ) and 1.13g more fiber per day ( $\chi^2 = 86.53, P < 0.001$ ) compared to infrequent breakfast consumers.<sup>27</sup> The established associations of habitual breakfast eating are vast and wholly beneficial and as additional research develops, it has become apparent that breakfast skipping can be as detrimental as habitual breakfast eating is advantageous.

### **Detrimental effects of habitual breakfast skipping**

Foregoing breakfast appears to be just as harmful as regular breakfast consumption is beneficial. In Dialektakou's study, with 24 varied breakfast definitions, breakfast skipping was significantly associated with increased BMI ( $P < 0.05$ ), [and this](#) remained true after adjusting for factors such as physical activity, parental education, socioeconomic status, and education level.<sup>47</sup> One study with over 4,000 children and

adolescents found that students who only ate breakfast 0-1 weekdays per week were almost twice as likely (OR:1.8; 95% CI 1.38-2.36) to be overweight than their counterparts that ate breakfast more than three times per week.<sup>30</sup> This trend was also prevalent in a large NHANES sample (n=9659) examining these associations in children (9-13 years old) and teens (14-18 years old). Deshmukh- Taskar et al. concluded that breakfast skippers in their sample had higher body mass index for age scores (P<0.05), larger average waist circumferences, increasing from 1.7-3.3cm (P<0.05), and a greater prevalence of obesity, than regular breakfast consumers and cereal eaters.<sup>22</sup> Among the breakfast skippers, 22.1% of the sample were classified as obese, whereas among breakfast consumers 18.4%, and ready to eat cereal consumers only 15.2% were classified as obese (P<0.05). The relationship between breakfast skipping and increased body weight has been well established;<sup>22,26,27,30-31,39,43-44,47-48,51-51</sup> what is less clear is if healthy habits, including regular breakfast consumption, formed early in life will persist along with their beneficial effects on body weight.

To address this question, Timlin et al. conducted research to determine if this trend remains through development and evolving dietary patterns. In that study, researchers reviewed adolescent eating habits at two different intervals in order to assess the relationship between body weight and breakfast habits over a five-year period. During the first wave of data collection a higher BMI was observed in adolescents that consumed breakfast intermittently ( $22.5 \pm .12 \text{ kg/m}^2$ ) or never ( $23.4 \pm .24 \text{ kg/m}^2$ ). While only 27.2% of females and 37.9% of males reported daily breakfast consumption, this group also had the lowest BMI ( $21.7 \pm 0.16 \text{ kg/m}^2$ ) (P<0.05).<sup>43</sup> After five years of follow-up and statistical adjustment for normal growth, the inverse relationship between frequency



of breakfast and BMI remained ( $P < 0.01$ ) among the girls and boys who reported daily breakfast consumption. Breakfast consumers exhibited significantly less of an increase in BMI compared to participants that ate breakfast intermittently or skipped the meal ( $1.6 \pm 0.16$  kg/m<sup>2</sup>,  $2.0 \pm 0.09$  kg/m<sup>2</sup>, and  $2.2 \pm 0.19$  kg/m<sup>2</sup>; respectively). The authors went on to note that other dietary factors, such as total energy consumption, alcohol use, ratio of macronutrients consumed, daily fiber intake, and food groups at breakfast, did not seem to explain the relationship. This study did observe that those participants from a more favorable socioeconomic status (SES) were more likely to consume daily breakfast than those who were from a less favorable SES ( $P \leq 0.01$ ).<sup>43</sup> In agreement with this, Agostoni et al. concluded that parents' behaviors and family food environment significantly impacts child breakfast behavior.<sup>36</sup> The correlation between breakfast and other favorable health promoting activities has been further explored as described below.

Metabolically and emotionally a breakfast that is consumed in a positive environment and consists of a balanced energy supply may produce favorable long-term health results.<sup>36</sup> The authors suggest targeting nutrition interventions to low income and disadvantaged populations for greatest impact, stating that parental encouragement of breakfast in the home and/or participation with schools to support breakfast programs may be a powerful tool to amplify effects of existing nutrition interventions. This could be extremely valuable for youth at risk for lifelong struggles with obesity and related chronic illnesses.<sup>42</sup> While numerous obstacles to consuming breakfast exist, it is likely that those subjects who identify as lower SES are eligible for participation in the NSBP allowing them the opportunity to receive the vast benefits discussed above of habitual breakfast consumption.

## **The National School Lunch and Breakfast Program**

The NSLP was established in 1946 and has grown to more than 100,000 participating schools. In 2013 alone, \$11.5 billion dollars was spent to serve over 30.7 million students meals. <sup>53</sup> Participating schools must meet specific nutrient guidelines based on the USDA's Dietary Guidelines for Americans. The latest school lunch reform occurred in 2012 with the implementation of the HHFKA<sup>54</sup> which required schools to offer more fruits and vegetables and include more whole grains among many other regulations and restrictions (Appendix B). Schools must meet the following restrictions while remaining within calorie restrictions and serving sizes for appropriate age groups: offer fruits and vegetables as two separate meal components; offer fruit daily at breakfast and lunch; offer vegetables daily at lunch, including specific vegetable subgroups weekly (dark green, orange, legumes, and other as defined in the 2005 Dietary Guidelines) <sup>54</sup> and a limited quantity of starchy vegetables throughout the week; offer whole grains (half of the grains would be whole grain-rich upon implementation of the rule and all grains would be whole-grain rich two years post implementation); offer a daily meat/meat alternate at breakfast; offer fluid milk that is fat-free (unflavored and flavored) and low-fat (unflavored only); offer meals that meet specific calorie ranges for each age/grade group; reduce the sodium content of meals gradually over a 10-year period through two intermediate sodium targets at two and four years post implementation; prepare meals using food products or ingredients that contain zero grams of trans fat per serving; require students to select a fruit or a vegetable as part of the reimbursable meal; use a single food-based menu planning approach; and use narrower age/grade groups for menu planning.<sup>55</sup>

The NSBP was established in 1966. <sup>55</sup> Ninety percent of the schools that participate in

the NSLP also participate in the NSBP.<sup>56</sup> This program must also meet strict federal standards as listed above. School breakfast programs must provide 25-30% of the participant's daily calorie consumption, which is calculated by age.<sup>56</sup> The meal must also meet one fourth of the participants recommended dietary allowance (RDA) of protein, calcium, iron, vitamin A, and vitamin C.<sup>56</sup>

The NSLP and NSBP are particularly important because 95% of all children and adolescents ages 5-17 spend most of their day and consume the majority of their daily calories in the academic setting.<sup>57</sup> A la carte options, vending machines, school stores and fundraisers, and classroom celebrations all contribute to variance in caloric consumption in the academic setting. It should also be noted that even with strict national breakfast and lunch standards fewer than ten percent of children and adolescents in the United States consume the recommended number of servings of fruits and vegetables daily.<sup>58</sup> Yet increasing fruit and vegetable consumption is a CDC recommended strategy to combat childhood obesity.<sup>59</sup> The AND, School Nutrition Association, and Society for Nutrition Education all agree that comprehensive, integrated nutrition services are an essential component that may improve nutritional status and health.<sup>60</sup> One method that may further improve fruit and vegetable consumption in schools is implementation of F2S programs.

### **Farm to School**

A F2S program is defined as a school that incorporates food from local or regional farms into school meals. The radius of distance of F2S is not stringently defined; but instead has commonly ranged from 20 to 200 miles of the school. Programs such as these are included as a comprehensive and integrated nutrition service<sup>60</sup> and have been identified as a strategy to fight childhood obesity.<sup>61</sup> The Farm to School Network, a

nationwide advocacy group and networking base, states that students gain access and exposure to healthy, seasonal, and local foods. Students also are commonly involved with school gardens, cooking lessons, and farm field trips.<sup>62</sup> They believe that F2S programs empower children and families to make healthier choices while supporting the local economy by providing stable revenue for farmers in the region. Further, they hypothesize that F2S programs influence the adoption of early lifelong, healthy dietary behaviors contributing to achievement and maintenance of a healthier body weight in childhood as well as adulthood.<sup>62</sup>

Nationally over 40,000 schools have initiated a F2S program according to the 2015 Farm to School Census, this is roughly 42% of the nation's schools.<sup>62</sup> The data from the Farm to School Census is self-reported, and likely reflects a wide range of mildly developed to mature F2S programs. Nationally, over \$598 million was invested in local communities to implement F2S programs.<sup>62</sup> In addition to non-federal financial support, from 2013-2015, \$15.1 million dollars of federal funding was awarded to school districts through grants for planning, implementing, supporting, or training staff for F2S programs, further contributing to the increasing prevalence of F2S programs in the nation.<sup>62</sup>

A wide range of development tools and funding opportunities exist for schools to utilize in attempt of implementing a F2S program. Many external and internal factors determine how attainable, sustainable, intensive, and successful the F2S program will be. Without strict definition of F2S programs the program can range from serving local dairy from a region as big as the northwest several times, or serving local vegetables from less than 50 miles away throughout the school year. This ambiguity remains true in regards to educational components as well. As stated, most schools do pair F2S meals with

curriculum. But this curriculum varies in intensity and does not always remain after the hype of the new program has dwindled. This ambiguity in definition is a weakness of the F2S program, and should remain a focus if the program is to be valued as a potential strategy for preventing childhood obesity.

Despite variance in F2S, the district chosen in this study has flourished into one of the more advanced F2S programs. The program primarily serves food from nine farms within 50 miles of the school district. The program was implemented in 2009 and continues to hold events such as Harvest Of The Month and Taste of Washington. The school purchased \$104,000 of local produce during the 2015/2016 school year. Other ingredients produced locally and used in school foods include dairy products, beef, legumes, and grain. The program has developed into one of the leading F2S models in the state and country.

### **Proposed benefits of F2S programs**

As prevalence of F2S programs increase rapidly, from less than ten in 1998 to approximately 40,000 in 2015, it's pertinent to understand the existing and potential benefits of the program. A 2008 meta-analysis by Joshi et al., including 15 studies, analyzed the potential advantageous outcomes of F2S programs.<sup>63</sup> It should be noted, that only four of those studies were peer-reviewed. This meta-analysis demonstrates an overall lack of research regarding the benefits of F2S programs and illustrates a need for further inquiry. Joshi himself states that more research must be done to determine what types of beneficial effects these programs may have on the students and surrounding community.<sup>63</sup> In his analysis, he categorized studies into the following groups: individual behavior change; change in diet and other behavior of students/teachers/staff/parents;

changes in food service operations; and changes in farm sales/transactions. One positive outcome that was observed was that students who participated in F2S programs were more likely to consume extra fruits and vegetables per day than those who participated in traditional NSBPs and NSLPs, 11 of the 15 studies analyzed observed increases from 25-84% in daily intake.<sup>63</sup> This correlation was hypothesized to be related to increased offering of fruits and vegetables and enhanced attention to seasonal and local produce. This is noteworthy due to the fact that 60% of children do not meet daily fruit recommendations and 93% do not meet daily vegetable recommendations.<sup>64</sup>

Additionally, the AND as well as the IOM recommend increasing fruit and vegetable intake as a prevention strategy for obesity<sup>14,60</sup> which is in line with the F2S program's objectives. Of the studies Joshi reviewed, five of them evaluated dietary intake and changes at home in addition to behavior change while participating in a F2S program. The majority, four of the five studies, did observe an increased fruit and vegetable consumption outside of school as well.<sup>63</sup> This phenomenon may be influenced by the overall hype of the program in the academic setting, educational components that are typically introduced simultaneously to local foods offerings in the school meals, or by new food exposure and opportunity to try certain foods otherwise left unknown. This contributes to existing evidence that participation in the F2S program could be a valuable strategy to prevent or reduce obesity, due to its related behavior change in the school and home setting; lifestyle behavioral changes that may have long-term positive effects.

School meal participation also increased; however, it's unknown whether this effect was lasting or a temporary interest in new school food service changes. Of the 15 studies, only one used BMI as an indicator for F2S success and the researchers did not

find any significant decreases in BMI with participating children.<sup>63,65</sup> This nine-month intervention study included several nutrition education components that encouraged kindergarteners to eat local, seasonal foods and be more aware of their community's food system. With such a short duration of participation, it is likely that the length of the intervention was not sufficient to significantly decrease BMI.<sup>65</sup> Additionally, school food service employees were not involved in the implementation of the study perhaps further diminishing the effectiveness of the intervention. Few reports have evaluated more mature F2S programs with only two of the studies evaluated having had programs two or more years old.<sup>63</sup> Older F2S programs have been associated with greater behavior change and health benefits.<sup>66</sup> For example, a F2S evaluation report was conducted by LaRowe et al. in Wisconsin that examined multiple F2S programs consisting of a range of F2S program implementation and levels of maturity. Primarily attitudes towards food, specifically fruits and vegetables, and general nutrition knowledge were assessed. Researchers found that schools with existing, older, F2S programs had higher scores of positive food and nutrition attitudes.<sup>66</sup> This trend was significant at baseline and follow up. All participating schools experienced improvements in attitudes and behaviors towards food and nutrition as evidenced by survey responses; and thus, the authors concluded that gradual, yet sustainable, positive changes on students' behaviors and attitudes is achievable.

Regardless of the lack of research on this topic, Joshi in a more recent publication, suggests a F2S program may be a causal pathway to prevent childhood obesity.<sup>67</sup> Even with limited data, F2S programs show increased levels of positive food awareness, willingness to try new foods, likelihood to make healthy choices, and increased

consumption of fruit and vegetables.<sup>67</sup> F2S programs even had a potential positive effect on family diets, parental knowledge, and healthy eating habits as previously noted.<sup>67</sup> Joshi argues that F2S programs, although difficult to sustain and requiring of resources (to be discussed below), are associated with the achievement of behavioral changes related to positive activities, healthier environments, and increased educational components such as cooking demos, learning gardens, and field trips. These components take place in the cafeteria, classroom, outdoor learning spaces, family, home, and community. This environmental change in turn may alter the child's attitude, skills, and behavior, and if positively reinforced, may have the additional effect of reducing the risk of childhood obesity.<sup>67-72</sup>

While the potential benefits of F2S programs are evident, barriers to implementation exist. Food service directors note that maintaining a F2S program and its educational components is challenging.<sup>67</sup> Programs often run with help of volunteers and funding via grants, two unsustainable resources in the longer term. Even with the noted challenges, Joshi observes that F2S programs have the potential to support good health, nutrition, agriculture, and local economy in any location.<sup>67</sup>

As F2S programs are still relevantly new, they have not been completely or sufficiently evaluated, there are many gaps in the literature yet it remains evident they have promising potential and may yield significant impact on reductions in childhood obesity rates. Given the benefits associated with regular consumption of breakfast, the NSBP is an ideal setting to evaluate F2S programs' benefits on body weight; especially given the NSBPs rigidly defined standards and guidelines. Unlike many other studies that contain ambiguity in breakfast definition, school breakfast is highly regulated and



controlled. Furthermore, the breakfast setting provides a better platform to measure effects of F2S than lunch because it is more highly correlated and predictive of BMI.<sup>31</sup> Since childhood obesity remains a significant public health problem nationally, public school venues to reduce childhood obesity are highly worthy of exploration.

### **Conclusion and Study Objectives**

The purpose of this study is to determine if school breakfast participants in F2S programs have lower BMIs than school breakfast participants in schools without F2S programs and if the frequency of participation has an impact of BMI. Specifically, we hypothesize that students who participate in the NSBP in schools who have enacted F2S will have a lower BMI than students who participate in the traditional NSBP. Additionally, we hypothesize those students who consume breakfast the most frequently will demonstrate lower BMIs compared to infrequent breakfast consumers, regardless of traditional or F2S participation. Our study compares two districts with similar demographics and access to local foods. One district has a more mature F2S program that includes a variety of educational components. The other has a traditional NSBP and NSLP and does not promote or participate in similar curriculum. As the F2S movement continues to grow it is valuable to understand how this movement affects childhood obesity, specifically in regards to breakfast, as it has been strongly correlated with reduced risk for obesity.

**CHAPTER III**  
**JOURNAL ARTICLE**

NATIONAL SCHOOL BREAKFAST PROGRAMS WITH IMPLEMENTATION OF  
FARM TO SCHOOL HAVE NO INFLUENCE ON BODY WEIGHT AMONG 3<sup>RD</sup> AND  
4<sup>TH</sup> GRADE STUDENTS

**National School Breakfast Programs with Implementation of Farm to School Have No Influence On Body Weight Among 3<sup>rd</sup> and 4<sup>th</sup> Grade Students.**

Category: Research in Action

Total word count: 4000 (excluding references)

Authors:

Hannah Brzozowski, RD

Dana Ogan, MS, RD, Assistant Professor  
Central Washington University,  
400 E University Way, Ellensburg WA 98926

Tim Englund, Ph.D. Dean of College of the Sciences  
Central Washington University,  
400 E University Way, Ellensburg WA 98926

Nicole Stendell-Hollis (corresponding author), Ph.D., RD, Assistant Professor  
Central Washington University,  
400 E University Way, Ellensburg WA 98926  
509.963.3360  
stendellhollisn@cwu.edu

<b>Table of Contents</b>	<b>Word Count</b>
Abstract	300
Introduction	702
Methodology	658
Study Design	
Study Sample	
Data Collection	
Data Analyses	
Results and Discussion	1085
Socioeconomic Status and Ethnicity	
Anthropometric Data	
School Breakfast Location	
Strengths and Limitations	

Conclusions and Application	926
Acknowledgements	41
References	
Consort Diagram	89
Tables	282

Table 1: Sample Demographic Information

Table 2: Mean BMI-for-Age compared by grade, gender, breakfast frequency, and eligibility

## **ABSTRACT**

### **Objectives:**

To examine the association between frequency of breakfast consumption on body mass index (BMI) among third- and fourth-grade students participating in the National School Breakfast Program (NSBP) compared to those participating in Farm to School (F2S) programs within the NSBP.

### **Methods:**

This cross-sectional study matched ten schools, five with F2S (A), and five with a traditional NSBP (B). Third- and fourth-grade students (n=1031) were recruited for study participation. Demographic information, frequency of breakfast participation, and anthropometric data were collected. BMI and frequency of breakfast consumption over a ten-day period, excluding non-school days, was stratified by frequent eaters (7-10), occasional eaters (3-6), and skippers (0-2).

### **Results:**

No significant difference in BMI-for-age between F2S (A) and traditional NSBP (B) was observed. There was also no significant correlation between BMI or BMI-for-age and breakfast participation observed. This data suggests that there is no effect of F2S participation on BMI-for-age and no correlation between breakfast consumption and BMI-for-age among third- and fourth-grade students. Hispanic and Latino students were more likely to qualify for free and reduced lunch ( $P < 0.001$ ). Free and reduced school meals students were more likely to be overweight or obese than students that qualify for paid school meals ( $P < 0.001$ ). In both districts, students that were offered breakfast in the classroom were 30% more likely to participate than students offered breakfast in the cafeteria.

**Applications to Child Nutrition Professionals:**

The F2S program is unlikely to be an effective strategy to prevent/reduce childhood overweight and obesity unless more fully implemented. Future strategies should focus on lower socio-economic status students and minority groups due to their increased rates and predisposition of overweight and obesity. Offering breakfast in the classroom may be a positive method of increasing breakfast participation in all types of school breakfast programs.

**Keywords:** schools, farm-to-school, breakfast, childhood obesity, classroom breakfast.

## INTRODUCTION

Childhood overweight and obesity remain a persistent concern nationally. Although the increasing rate of childhood obesity has slowed to 17% (Ogden et al., 2014), a large percentage of children still suffer physically, emotionally, socially, and even academically from the detrimental effects of overweight and obesity (Fryar et al., 2012; Schwimmer et al., 2003; Fox et al., 2009; Geier et al., 2007; Hesmat et al., 2014; Biro et al., 2010). Consequences are not limited to childhood years: overweight and obese children often enter middle adulthood with more severe forms of chronic diseases such as diabetes, cardiovascular diseases, and select cancers, contributing to an overall diminished quality of life (Juonala et al., 2010; Dietz, 1998; Biro, 2010; Singh et al., 2008; Weiss et al., 2004). Beyond the physical health concerns, these conditions often co-exist with food insecurity, poverty, and hunger; creating a web of political and health issues requiring national attention (Hoelscher et al., 2004; Healthy People, 2015; State of Obesity 2015).

Due to the multifaceted cause of obesity there is an array of recommended strategies targeting childhood overweight and obesity proposed by various health organizations. These include, but are not limited to: early child- and school-based interventions, policy-based interventions, and food marketing interventions (Hoelscher et al., 2013; IOM, 2004; Healthy People, 2015; CDC, 2014). The National School Lunch Program (NSLP) and National School Breakfast Program (NSBP) provide a promising platform to increase nutritional health and health awareness among children and

adolescents.

School food components, which are federally regulated by the United States Department of Agriculture (USDA), were recently updated in 2012 with the Healthy, Hunger-Free Kids Act (HFFKA). This act required schools to provide more fresh produce, half of all grain servings as whole grains, and reduce the sodium content of meals among other various changes intended to improve the nutritional quality of school meals. Other school-based interventions include regulating available beverage and vending machine choices, promoting increased physical activity, and implementing Farm to School (F2S) programs (Briggs et al., 2010).

The F2S program is a nationwide initiative to include more local produce, dairy, meat, and grain products within school meals. Almost half of the nation's schools claim to have a F2S program, with over \$15 million federal dollars spent on initiating and sustaining the programs (National Farm to School Network, 2016; Farm to School Census, 2015). The F2S program is collectively presented with relevant educational components, such as farm tours, school gardens, and interactive events encouraging students to think about where their food comes from. Currently, the program is a recommended strategy to prevent or reduce childhood obesity by the Institute of Medicine (IOM) (Hoelscher et al., 2013; Farm to School Census, 2015), though very few studies have examined the relationship between F2S participation and body mass index (BMI) to date (LaRowe et al., 2012; Joshi et al., 2008).

The effects of the F2S program may be especially visible when measuring

breakfast consumption habits. A relationship between regular breakfast consumption and a healthy body weight has been identified by numerous studies (Schwimmer et al., 2003; Kleinman et al., 2002; Widenhorn-Muller et al., 2008; Murphy et al., 1998; Adolphus et al., 2013; Deshmukh-Taskar et al., 2010; Pereira et al., 2011; Kant. Andon et al., 2008; Rampersaud et al., 2005; McCrory et al., 2011; Gleason et al., 2007). Ultimately, as discussed in O'Neil's research commentary in 2014, the definition of breakfast affects the strength of the observed association between breakfast consumption and body weight. The NSBP, due to its highly regulated nature, is likely to demonstrate this inverse relationship, while promoting healthy lifestyle behaviors that may reinforce lasting maintenance of a favorable body weight.

This study aimed to explore the effect of F2S participation on childhood BMI, and furthermore if regular participation in the NSBP amplifies the proposed benefits between F2S and body weight status. If the F2S program has benefits such as increased exposure to healthy foods, positive attitude surrounding food systems and health, and increased consumption of fruit and vegetables it's likely to also have a positive effect on body composition. As the F2S movement continues to grow it is valuable to understand how the program affects childhood obesity, specifically in regards to breakfast as it has been highly correlated with reduced risk for obesity.

## **METHODOLOGY**

### **Study Design**

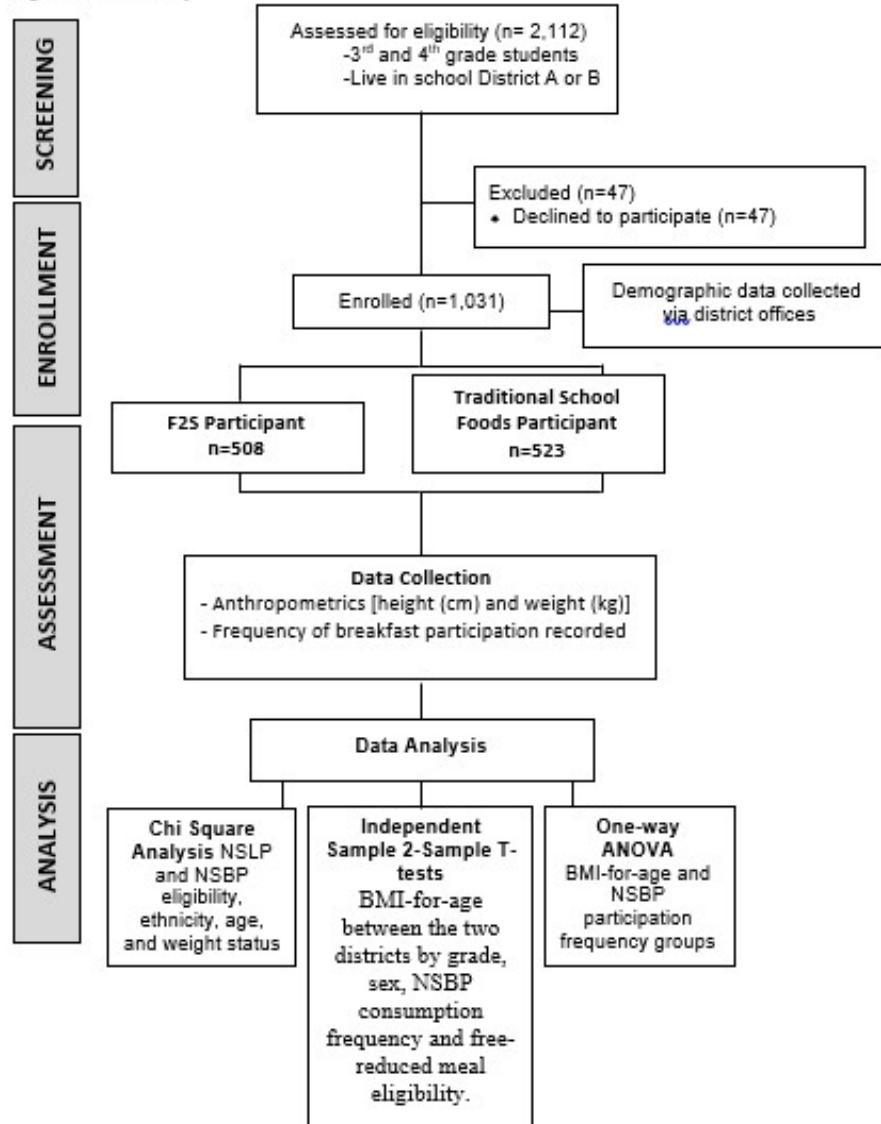
This study was a cross-sectional design assessing the effect of frequent breakfast



consumption and F2S participation on BMI among third- and fourth-grade students. The study protocol was reviewed and approved by Central Washington University's Institutional Review Board prior to collection of any data. All guardians were mailed study information and were provided with opt out forms, envelopes, and postage if they did not want their child to participate. Assent was attained from students prior to data collection. Students were informed that they could choose to opt out at any time.

## STUDY DESIGN

Figure 1: Flow of study



**Table 1. Sample Demographic Information.**

	<b>District A (F2S)</b>	<b>District B (NSBP)</b>
NSLP & NSBP Eligibility % (n)		
Free	56.6% (n=288)	53.5% (n=280)
Reduced	8.3% (n=42)	10.9% (n=57)
Paid	35.0% (n=178)	35.5% (n=186)
Ethnicity % (n)		
Hispanic or Latino	53.1% (n=270)	49.9% (n=261)
Non-Hispanic White	43.7% (n=222)	46.2% (n=242)
Age (Mean, SD)		
Years	9.2 ± .8	9.1 ± .8
Weight Status % (n)		
Underweight	2.5% (n=13)	1.3% (n=7)
Normal	50.6 % (n=257)	55.8% (n=292)
Overweight	19.7% (n=100)	17.5% (n=91)
Obese	29.9% (n=137)	25.4% (n=133)
N total	508	523

Status ranked according to CDC standards. BMI-for-age is an index of weight-for-height that is based on a normal distribution of the national population. Underweight (<5%), normal (5-85%), overweight (85-95%), and obese (>95%). None of the above measures were statistically significantly different

between districts.

## **Study Sample**

The study sample included ten elementary schools, from adjacent school districts in North Central Washington. Five with F2S breakfast programs (A), and five with traditional NSBP (B) were selected. Third- and fourth-grade students (N=1031) were recruited for participation. This age group was selected due to two or more probable years of F2S participation. Furthermore, this age group is less likely to be as affected by peer social influence of school meal participation compared to older children (Adolphus et al., 2013). All third- and fourth-grade students within districts were eligible for participation in this study. This resulted in 568 students who qualified for free-breakfast, 99 students who qualified for reduced-breakfast, and 364 students who purchased their breakfast (**Figure 1**). Might want to mention demographic profile

## **Data Collection**

*Demographic data.* Demographic data was collected from each district office and through statewide public reports. Ethnicity as well as individual, district, and state wide free and reduced lunch status were assessed.

*Anthropometric data.* Anthropometric data (height [cm] and weight [kg]) were collected by trained investigators and co-investigators following standardized procedures in a private location. Standing height was measured using a portable stadiometer (Charder HM200P Portstad) to the nearest 0.1 cm. Weight was measured using a portable, digital display floor scale to the nearest 0.1 kg (Detecto SlimPRO Digital Low Profile). All equipment was calibrated prior to use. Participants were asked to remove heavy clothing; footwear remained on for all subjects. Participants were unable to see their recorded

measurements, height and weight was kept confidential and not shared with other subjects.

*School breakfast participation data.* School breakfast participation information was retrieved from the databases at each food service establishment; Mealtime by the CLM Group Inc. at district A and NutriKids by Heartland Payment Systems at district B. Participation of breakfast and lunch was recorded in a consecutive ten-day span, excluding non-school days. Only frequency of breakfast consumption was recorded; meal components or nutrients consumed were not recorded. Frequency of breakfast was organized into three groups; skippers (0-2 meals), occasional eaters (3-6 meals), and frequent breakfast consumers (7-10 meals).

### **Data Analyses**

Summary statistics (means, standard deviations, ranges) were calculated for baseline characteristics. BMI-for-age was calculated using anthropometric data collected and birthdates provided by district office database. The software used for analysis was the Center for Disease Control and Prevention's (CDC) group BMI calculator, English v1.1 (Center for Disease Control, 2015). Chi-square tests were used for NSLP and NSBP eligibility, ethnicity, age, and weight status sample comparisons. Independent 2-sample t-tests were used to compare BMI-for-age between the two districts by grade, sex, NSBP consumption frequency and free-reduced meal eligibility. One-way ANOVA was used to compare BMI-for-age and NSBP participation frequency groups. In a *post-hoc* analysis, the effect of the location of breakfast was also assessed. The SPSS 20.0.0.0 software was used for analysis. Significance was set at 0.05.

## RESULTS AND DISCUSSION

In contrast to our hypothesis, there was no difference in BMI-for-age among third- and fourth-grade students regardless of participation in a traditional NSBP or a NSBP with a F2S program. There was no relationship observed between BMI and breakfast participation frequency.

### **Socioeconomic Status and Ethnicity**

No significant differences in summary statistics between districts were demonstrated; indicating a highly homogenous sample (**Table 1**). The majority of students at each district qualified for free- or reduced-breakfast demonstrating a similar socioeconomic status (SES) distribution ( $P = 0.48$ ). However Hispanic/Latino students (comprising 71.3% of the sample who qualified for free and reduced meals) were more likely than non-Hispanic white students to qualify ( $P < 0.0001$ ). Other ethnicities were not included in this statistical analysis due to their very small prevalence within the sample.

The overall sample had a similar ethnic profile with no significant differences noted. Hispanic/Latino students comprised a large portion of the sample. Though the majority of the entire sample had normal BMI-for-age ( $n=527$ ), a greater proportion of Hispanic/Latino students were classified as obese/overweight (65.3% and 60.8%, districts A and B, respectively) compared to non-Hispanic white students (36.4% and 34.3%, districts A and B, respectively  $P < 0.0001$ ).

**Table 2.** Mean BMI-for-Age compared by grade, gender, breakfast frequency, and eligibility.

	<b>District A</b>	<b>District B</b>
<b>BMI-for-Age (% + SD)</b>		
3 <sup>rd</sup> Grade Girls	68.5 + 30.3	72.6 + 24.4
3 <sup>rd</sup> Grade Boys	71.3 + 27.9	75.0 + 24.0
4 <sup>th</sup> Grade Girls	69.0 + 27.9	71.3 + 26.5
4 <sup>th</sup> Grade Boys	73.0 + 28.5	73.9 + 25.6
<b>Breakfast Frequency (% + SD)</b>		
Skippers	69.4 ± 29.2	71 ± 27.1
Occasional	75.8 ± 26.72	75.7 ± 24.9
Frequent	70.9 ± 26.8	76.4 ± 19.5
<b>NSLP + NSBP Eligibility (% + SD)</b>		
Free	74.5 ± 26.5	76.3 ± 24.1
Reduced	66.4 ± 34.5	72.6 ± 24.9
Paid	65.1 ± 29.5	68.6 ± 26.1

Status ranked according to CDC standards. BMI-for-age is an index of weight-for-height that's based on a normal distribution of the national population. Underweight (<5%), normal (5-85%), overweight (85-95%), and obese (>95%). None of the above measures were statistically significantly different between districts.

## **Anthropometric Data**

No significant differences were found between weight status and school districts (**Table 1**). Of our entire sample, 26% were classified as obese based on BMI-for-age; much higher than the national average of approximately 17% (Center for Disease Control, 2015). This discrepancy between our sample and the national population may have attenuated the F2S program's ability to positively affect body weight status.

No significant differences were found between BMI-for-age and grade or gender. Though BMI-for-age averages were slightly less in all categories in district A, all mean BMI-for-age scores fell within normal weight status percentiles (5<sup>th</sup> < 85<sup>th</sup> percentile-for-age; **Table 2**); although it should be noted that they were much higher than the expected average of 50%.

No significant differences were found between districts when stratified by breakfast frequency consumption. As **Table 2** illustrates, skippers, occasional eaters, and frequent eaters all had mean BMI-for-age scores within normal weight status percentiles (5<sup>th</sup> < 85<sup>th</sup> percentile-for-age); although again, markedly above the average of 50%.

With complete sample analysis of all participants in both districts, statistically significant relationships were observed between students that qualified for free breakfast and lunch and overweight and obesity status ( $P < 0.001$ ); as well as between students who purchased breakfast and a normal BMI-for-age status ( $P < 0.001$ ). This supports previous literature (Timlin et. al., 2008) suggesting SES status is inversely correlated with BMI. When districts were compared, no significant difference was found between free and reduced meal eligibility and BMI-for-age (**Table 2**).



## **School Breakfast Location**

In a *post-hoc* analysis it was observed that children who consumed breakfast in the classroom had greater participation in the NSBP regardless of whether the school had implemented a F2S program. In both school districts, students were 30% more likely to consume breakfast at school if it was served in the classroom rather than the cafeteria ( $P < 0.05$ ; data not shown). However, BMI-for-age was not statistically different among classroom and cafeteria eaters. Of the classroom breakfast eaters, 51.6% qualified for free school meals, making the SES distribution of classroom breakfast eaters similar to the entire sample (51.1%).

Previous studies suggest offering breakfast in the classroom is a positive nutritional reinforcement as well as a potential strategy to increase academic performance and behavior (Food Research and Action Center, 2016, Adolphus et al., 2013). Adolphus et al., reviewed 21 studies analyzing habitual breakfast consumption and children and adolescent academic performance. They concluded participation in school breakfast positively impacted test scores. The effect was more apparent if breakfast met >20-25% of daily caloric needs, the NSBP is required to provide an estimated 25% of daily needs. In addition to positive academic and behavior outcomes, increased habitual breakfast participation within the classroom it is likely to have a positive effect on childhood BMI. Although not demonstrated in this study, numerous studies have illustrated an inverse relationship between breakfast consumption and BMI (Affenito et al., 2007, Baldinger et al., 2012, Merten et al., 2009, Szajewska et al., 2010, Timlin et al., 2008).

In contrast, some researchers argue breakfast in the classroom as an unfavorable addition of excess calories for children that may be consuming breakfast both at home and school (Van Wye et al., 2013). During a NSBP study, it was noted that over 20% of students consumed more than one breakfast. Of the double breakfast consumers, almost half (46%) consumed a nutritionally substantive breakfast prior to consuming school breakfast (Bernstein et al., 2004). However, in Bernstein's study, no anthropometric data was collected to determine a potential positive or negative influence on BMI. Wang et al. measured weight gain over two academic years and assessed breakfast habits; the authors concluded that even those students who consumed breakfast at home as well as at school had more favorable BMIs than those who skipped breakfast all together, which further supports the role of breakfast in maintaining a healthy body weight ( $P < 0.05$ ) (Wang et al., 2016).

### **Strengths and Limitations**

This study hypothesized that with F2S exposure an effect on BMI would be measurable, but without subjective data analysis, it is impossible to determine if attitudes towards food or dietary behaviors have changed or improved. The history and level of involvement in F2S related programs were also not measured in our study. Variance may occur by teacher, school year, or schools within district. Lastly, limited information on educational level, demographics, anthropometric data, or health behavior of the legal guardians was not obtained; all of which may significantly influence childhood BMI status.

It is likely we did not see a statistically significant effect of the F2S program on body weight in part due to the high percentage of students classified as obese and of a lower SES; both known risk factors for childhood obesity (Timlin et al., 2008). Significant results may have been more likely with a population with average obesity rates. Despite the noted limitations, this research is one of very few studies that evaluated F2S and BMI-for-age. Other strengths include: the large sample size; the high proportion of Hispanic/Latino students; and two homogenous populations that provided an excellent platform to control for extraneous variables. The region of North Central Washington is an agricultural hub, allowing the schools accessibility to grains, legumes, dairy, vegetables, orchard fruits, and meats locally. The same task would prove more challenging to a more urban school or a district in a less bountiful region.

## **CONCLUSIONS AND APPLICATIONS**

Although originally thought to be a promising strategy, our results show no significant effect on childhood BMI between participation in a F2S NSBP compared to a traditional NSBP. Our sample population had a higher prevalence of obesity than the national average (26% vs. 17%). This likely skewed our findings but emphasizes the need for these high-risk populations to be a primary focus of future childhood obesity interventions.

Additionally, it's likely the food served within NSLP and NSBP have little variance between districts due to strict regulations schools must already follow. With increased fruit and vegetable offerings among all schools due to the HHFKA; it's

improbable that F2S programs are in fact serving more fruit and vegetables than other schools. If in fact, F2S programs serve more fruit and vegetables, it's unknown if students are consuming more of them or contributing to greater overall food waste.

The F2S Network recommends a complete F2S program consist of procurement, education, and school gardens, but does not have detailed objectives. The current study found no relationships between F2S procurement and a healthy body weight; however, it's likely the educational components have a greater impact on a child's nutritional choices. We recommend that the educational components of F2S programs be expanded and more defined, as this component of F2S is likely a stronger contributor to child dietary habits than food served at NSLP and NSBP alone. We recommend that all schools, not just schools with F2S programs, develop and implement a standard nutrition curriculum. Additionally, in population's with markedly higher rates of obesity, such as our sample, a greater emphasis should be placed on nutrition education. It would be beneficial for schools to be aware of their school's obesity rates to align with this recommendation.

We recommend future studies analyze the population during different years within the child's schooling to analyze how the F2S program exposure affects child dietary patterns and body composition over time. We also recommend conducting a detailed history of F2S involvement to explore which aspects of F2S curriculum are most effective. For example, it would be helpful to know roughly how many school hours they spent learning about or working in the school garden, how many field trips each student participated in, and what nutrition-related events the child was exposed to. Nationally,

F2S programs have vast variability between programs, making it difficult to determine its true effect without more comprehensive measurement and analysis. The F2S program in our study, although mature, varies among season, year, schools within each district, grade level, and teacher. Nationally, programs range by ingredients purchased, volume of food purchased, promotion of the program, and extent of involvement in complementary educational components; all of which make comparing and measuring effects of programs challenging. This study revealed the need for school-based interventions, such as F2S, to be continuously evaluated and regulated. Future studies may consider surveying students on attitudes and experiences after involvement in such programs, in addition to evaluating BMI.

We did not observe a significant relationship between breakfast consumption and BMI; contrary to our hypothesis. Although our sample's prevalence of obesity is higher than the national average, skippers in our sample had a mean normal, but above average BMI-for-age. We did see a significant relationship between location of breakfast and participation. Regular breakfast participation has been correlated with an array of benefits in addition to favorable body composition. The NSBP provides a platform to address and improve our nation's food security status and the childhood obesity epidemic, while reinforcing healthy behaviors like habitual breakfast participation. Considering the positive effects of habitual breakfast as evidenced by previous research, school food services may elect to shift breakfast to the classroom instead of the cafeteria to extend on those benefits. Previous studies have also noted universal breakfast as a potential opportunity to increase food security, decrease hunger, increase meal participation,

increase school attendance, and enhance academic achievement (Leos-Urbel et al., 2013, No Kid Hungry, 2014). Universal breakfast, specifically in the classroom, should be further explored in hopes of expanding previously stated benefits to all students. Another area for expansion is Breakfast After The Bell, a program that integrates breakfast into the school day, often in the classroom, greatly improving the likeliness of breakfast consumption. Both types of SBPs could significantly increase meal participation while simultaneously reducing stigma that may be associated with school breakfast consumers. School food service staff and teachers may consider working together to offer breakfast in the classroom in hopes of providing optimal health and success for their school's student population.

In conclusion, the potential effectiveness of F2S programs as a promising obesity prevention or reduction was not illustrated by this study. This finding is likely related to the high obesity prevalence and low SES in the sample analyzed. Results showed that participation in school breakfast did not significantly impact BMI-for-age. Breakfast consumption participation increased significantly when breakfast was served in the classroom versus the cafeteria. This information may be beneficial for schools to not only increase participation rates but also enable more students to benefit from habitual breakfast, which has been historically associated with maintenance of a healthy body weight. Future classroom based interventions, like breakfast in the classroom, fruit and vegetable curriculum, and food system based lesson plans may be more favorable than food service based interventions, though it's clear external factors, such as SES, continue to highly influence a child's body weight. The results from this study suggest the need for

strong intervention and specific prevention methods to target this already high-risk population.

### **AWKNOWLEDGMENTS**

This research was in part funded by Central Washington University Graduate Studies. The contents of this publication do not necessarily reflect the views of the university. Thank you to participating school districts and students who volunteered their time as co-investigators.

## REFERENCES

### JOURNAL ARTICLE REFERENCES

Adolphus, K., Lawton, C. L., & Dye, L. (2013). The effects of breakfast on behavior and academic performance in children and adolescents. *Frontiers in Human Neuroscience*, 7(10.3389/fnhum.2013.00425). Retrieved from <http://dx.doi.org/10.3389/fnhum.2013.00425>

Affenito SG. Breakfast: A Missed Opportunity. *Journal of the American Dietetic Association*. 2007;107(4):565-569. <http://dx.doi.org/10.1016/j.jada.2007.01.011>

Baldinger N, Krebs A, Muller R, Aeberli I. Swiss children consuming breakfast regularly have better motor functional skills and are less overweight than breakfast skippers. *J Am Coll Nutr*. 2012;31(2):87–93. <http://dx.doi.org/10.1080/07315724.2012.10720013>

Bernstein LS, McLaughlin JE, Crepinsek MK, Daft LM. Evaluation of the school breakfast program pilot project: final report. Nutrition Assistance Program Report Series, No.CN-04-SBP. 2004

Biro, F. M., & Wien, M. (2010). Childhood obesity and adult morbidities. *The American Journal of Clinical Nutrition*, 91(5), 1499S–1505S. <https://doi.org/10.3945/ajcn.2010.28701B>

Briggs, M., Fleischhacker, S., Mueller, C. G., American Dietetic Association, School Nutrition Association, & Society for Nutrition Education. (2010). Position of the American Dietetic Association, School Nutrition Association, and Society for Nutrition Education: comprehensive school nutrition services. *Journal of Nutrition Education and Behavior*, 42(6), 360–371. <https://doi.org/10.1016/j.jneb.2010.08.007>

Children's BMI Tool for Schools. (2015). Retrieved December 06, 2016, from [http://www.cdc.gov/healthyweight/assessing/bmi/childrens\\_BMI/tool\\_for\\_schools.html](http://www.cdc.gov/healthyweight/assessing/bmi/childrens_BMI/tool_for_schools.html)

Center for Disease Control and Prevention: Children eating more fruit, but fruit and vegetable intake still too low. [Retrieved November 11, 2016]. Available from: <http://www.cdc.gov/media/releases/2014/p0805-fruit-vegetables.html>

Deshmukh-Taskar, P. R., Nicklas, T. A., O'Neil, C. E., Keast, D. R., Radcliffe, J. D., & Cho, S. (2010). The Relationship of Breakfast Skipping and Type of Breakfast Consumption with Nutrient Intake and Weight Status in Children and Adolescents: The National Health and Nutrition Examination Survey 1999-2006. *Journal of the American Dietetic Association*, 110(6), 869–878. <https://doi.org/10.1016/j.jada.2010.03.023>

Dietz, W. H. (1998). Health consequences of obesity in youth: childhood predictors of adult disease. *Pediatrics*, 101(3 Pt 2), 518–525.



[http://pediatrics.aappublications.org/content/101/Supplement\\_2/518](http://pediatrics.aappublications.org/content/101/Supplement_2/518)

Dubois, L., Girard, M., Potvin Kent, M., Farmer, A., & Tatone-Tokuda, F. (2009). Breakfast skipping is associated with differences in meal patterns, macronutrient intakes and overweight among pre-school children. *Public Health Nutrition*, 12(1), 19–28. <https://doi.org/10.1017/S1368980008001894>

Farm To School Census. (n.d.). Retrieved November 15, 2016, from <https://farmtoschoolcensus.fns.usda.gov/about>

Food Research and Action Center. (n.d.). The School Breakfast Program. Retrieved from [http://frac.org/wp-content/uploads/2009/09/school\\_breakfast\\_program\\_fact\\_sheet.pdf](http://frac.org/wp-content/uploads/2009/09/school_breakfast_program_fact_sheet.pdf)

Fox, C. L., & Farrow, C. V. (2009). Global and physical self-esteem and body dissatisfaction as mediators of the relationship between weight status and being a victim of bullying. *Journal of Adolescence*, 32(5), 1287–1301. <https://doi.org/10.1016/j.adolescence.2008.12.006>

Fryar C, Carroll M, Ogden C. Prevalence of Overweight, Obesity, and Extreme Obesity Among Adults: United States, Trends 1960–1962. Through 2009–2010. Available from: URL: [http://www.cdc.gov/nchs/data/hestat/obesity\\_adult\\_09\\_10/obesity\\_adult\\_09\\_10.htm](http://www.cdc.gov/nchs/data/hestat/obesity_adult_09_10/obesity_adult_09_10.htm)

Geier, A. B., Foster, G. D., Womble, L. G., McLaughlin, J., Borradaile, K. E., Nachmani, J., ... Shults, J. (2007). The relationship between relative weight and school attendance among elementary schoolchildren. *Obesity (Silver Spring, Md.)*, 15(8), 2157–2161. doi:10.1038/oby.2007.256v

Gleason, P. M., & Dodd, A. H. (2009). School Breakfast Program but Not School Lunch Program Participation Is Associated with Lower Body Mass Index. *Journal of the American Dietetic Association*, 109(2, Supplement), S118–S128. <https://doi.org/10.1016/j.jada.2008.10.058>

Healthy People 2020 [Internet]. Washington, DC: U.S. Department of Health and Human Services, Office of Disease Prevention and Health Promotion [Retrieved November 11, 2016]. Available from: <https://www.healthypeople.gov/2020/leading-health-indicators/2020-lhi-topics/Nutrition-Physical-Activity-and-Obesity/data>

Heshmat, R., Larijani, F. A., Pourabbasi, A., & Pourabbasi, A. (2014). Do overweight students have lower academic performance than their classmates? A pilot cross sectional study in a middle school in Tehran. *Journal of Diabetes and Metabolic Disorders*, 13. <https://doi.org/10.1186/s40200-014-0087-0>

Hoelscher, D. M., Kirk, S., Ritchie, L., Cunningham-Sabo, L., & Academy Positions Committee. (2013). Position of the Academy of Nutrition and Dietetics: interventions for

the prevention and treatment of pediatric overweight and obesity. *Journal of the Academy of Nutrition and Dietetics*, 113(10), 1375–1394.

<https://doi.org/10.1016/j.jand.2013.08.004>

No Kid Hungry. Increasing School Breakfast Participation. 2014.

<https://bestpractices.nokidhungry.org/school-breakfast/increasing-school-breakfast-participation>

Joshi, A., Azuma, A. M., & Feenstra, G. (2008). Do farm-to-school programs make a difference? Findings and future research needs. *Journal of Hunger & Environmental Nutrition*, 3(2-3), 229-246. <http://dx.doi.org/10.1080/19320240802244025>

Juonala, M., Magnussen, C. G., Venn, A., Dwyer, T., Burns, T. L., Davis, P. H., ... Raitakari, O. T. (2010). Influence of age on associations between childhood risk factors and carotid intima-media thickness in adulthood: the Cardiovascular Risk in Young Finns Study, the Childhood Determinants of Adult Health Study, the Bogalusa Heart Study, and the Muscatine Study for the International Childhood Cardiovascular Cohort (i3C) Consortium. *Circulation*, 122(24), 2514–2520.

<https://doi.org/10.1161/CIRCULATIONAHA.110.966465>

Kant, A. K., Andon, M. B., Angelopoulos, T. J., & Rippe, J. M. (2008). Association of breakfast energy density with diet quality and body mass index in American adults: National Health and Nutrition Examination Surveys, 1999–2004. *The American Journal of Clinical Nutrition*, 88(5), 1396–1404. <https://doi.org/10.3945/ajcn.2008.26171>

Kleinman, R. E., Hall, S., Green, H., Korzec-Ramirez, D., Patton, K., Pagano, M. E., & Murphy, J. M. (2002). Diet, breakfast, and academic performance in children. *Annals of Nutrition & Metabolism*, 46 Suppl 1, 24–30. <https://doi.org/66399>

LaRowe, T. L., Bontrager Yoder, A. B., Knitter, A., Meinen, A., Liebhart, J. L., & Schoeller, D. (2012). Wisconsin Farm to School: One year evaluation report. *Madison, WI: University of Wisconsin-Madison: Wisconsin Prevention of Obesity and Diabetes*. <http://www.cias.wisc.edu/foodservtools14/7-evaluate-your-work/farm-to-school-program-evaluation-report.pdf>

Leos-Urbel, J., Schwartz, A., Weinstein, M., Corcoran, S. (2013). Not just for poor kids: The impact of universal free school breakfast on meal participation and student outcomes. *Economics of Education Review*, 36, 88-107.

<http://dx.doi.org/10.1016/j.econedurev.2013.06.007>

Medicine, I. of. (2004). *Preventing Childhood Obesity: Health in the Balance*. Retrieved from <https://www.nap.edu/catalog/11015/preventing-childhood-obesity-health-in-the-balance>

McCrary, M. A., & Campbell, W. W. (2011). Effects of Eating Frequency, Snacking, and Breakfast Skipping on Energy Regulation: Symposium Overview. *The Journal of*

*Nutrition*, 141(1), 144–147. <https://doi.org/10.3945/jn.109.114918>

Murphy, J. M., Pagano, M. E., Nachmani, J., Sperling, P., Kane, S., & Kleinman, R. E. (1998). The Relationship of School Breakfast to Psychosocial and Academic Functioning: Cross-sectional and Longitudinal Observations in an Inner-city School Sample. *Archives of Pediatrics & Adolescent Medicine*, 152(9), 899–907.

<http://jamanetwork.com/journals/jamapediatrics/fullarticle/189855>

National Farm to School Network. (n.d.). Retrieved November 15, 2016, from

<http://www.farmentoschool.org/>

Ogden CL, Carroll MD, Kit BK, & Flegal KM. (2014). PRevalence of childhood and adult obesity in the united states, 2011-2012. *JAMA*, 311(8), 806–814.

<https://doi.org/10.1001/jama.2014.732>

O’Neil, C. E., Nicklas, T. A., & Fulgoni, V. L. (2014). Nutrient Intake, Diet Quality, and Weight/Adiposity Parameters in Breakfast Patterns Compared with No Breakfast in Adults: National Health and Nutrition Examination Survey 2001-2008. *Journal of the Academy of Nutrition and Dietetics*, 114(12), S27–S43.

<https://doi.org/10.1016/j.jand.2014.08.021>

Pereira, M. A., Erickson, E., McKee, P., Schrankler, K., Raatz, S. K., Lytle, L. A., & Pellegrini, A. D. (2011). Breakfast Frequency and Quality May Affect Glycemia and Appetite in Adults and Children. *The Journal of Nutrition*, 141(1), 163–168.

<https://doi.org/10.3945/jn.109.114405>

Rampersaud, G. C., Pereira, M. A., Girard, B. L., Adams, J., & Metz, J. D. (2005). Breakfast Habits, Nutritional Status, Body Weight, and Academic Performance in Children and Adolescents. *Journal of the American Dietetic Association*, 105(5), 743–760. <https://doi.org/10.1016/j.jada.2005.02.007>

Szajewska, H., & Rusczyński, M. (2010). Systematic review demonstrating that breakfast consumption influences body weight outcomes in children and adolescents in Europe. *Critical Reviews in Food Science and Nutrition*, 50(2), 113–119.

<https://doi.org/10.1080/10408390903467514>

Schwimmer, J. B., Burwinkle, T. M., & Varni, J. W. (2003). Health-Related Quality of Life of Severely Obese Children and Adolescents. *JAMA*, 289(14), 1813–1819.

<https://doi.org/10.1001/jama.289.14.1813>

Singh, A. S., Mulder, C., Twisk, J. W. R., van Mechelen, W., & Chinapaw, M. J. M. (2008). Tracking of childhood overweight into adulthood: a systematic review of the literature. *Obesity Reviews: An Official Journal of the International Association for the Study of Obesity*, 9(5), 474–488. <https://doi.org/10.1111/j.1467-789X.2008.00475.x>

State of Obesity - Moving Toward Modernizing Obesity Policies and Programs. (n.d.).

Retrieved November 11, 2016, from <http://stateofobesity.org/policy/schools-and-healthy->

<http://stateofobesity.org/policy/schools-and-healthy-weight/national-school-breakfast-and-lunch-programs-and-related-school-nutrition-initiatives>

Timlin MT, Pereira MA, Story M, Neumark-Sztainer D. Breakfast Eating and Weight Change in a 5-Year Prospective Analysis of Adolescents: Project EAT (Eating Among Teens). *Pediatrics*. 2008;121(3):e638-3645. <https://dx.doi.org/10.1542/peds.2007-1035>

Van Wye, G., Seoh, H., Adjoian, T., & Dowell, D. (2013). Evaluation of the New York City Breakfast in the Classroom Program. *American Journal of Public Health, 103*(10), e59–e64. <https://doi.org/10.2105/AJPH.2013.301470>

Wang S, Schwartz MB, Shebl FM, Read M, Henderson KE, Ickovics JR. School breakfast and body mass index: a longitudinal observational study of middle school students. *Pediatr Obes* (2016) 8. doi:10.1111/ijpo.12127

Weiss, R., Dziura, J., Burgert, T. S., Tamborlane, W. V., Taksali, S. E., Yeckel, C. W., ... Caprio, S. (2004). Obesity and the Metabolic Syndrome in Children and Adolescents. *New England Journal of Medicine, 350*(23), 2362–2374. <https://doi.org/10.1056/NEJMoa031049>

Widenhorn-Müller, K., Hille, K., Klenk, J., & Weiland, U. (2008). Influence of having breakfast on cognitive performance and mood in 13- to 20-year-old high school students: results of a crossover trial. *Pediatrics, 122*(2), 279–284. <https://doi.org/10.1542/peds.2007-0944>

## COMPREHENSIVE THESIS REFERENCES

Cynthia L. Ogden, Ph.D. MDC MSPH, Cheryl D. Fryar, M.S.P.H KMF Ph .  
Prevalence of Obesity Among Adults and Youth: United States, 2011–2014. *US DEPARTMENT OF HEALTH AND HUMAN SERVICES*. 2015;NCHS Data Brief (No. 219).

Cheryl D. Fryar, M.S.P.H MDC MSP., Cynthia L. Ogden, Ph.D. Prevalence of Overweight and Obesity Among Children and Adolescents: United States, 1963–1965 Through 2011–2012. *Center for Disease Control, National Center for Health Statistics*.

Koplan, J. P., Liverman, C. T., Kraak, V. I., & Committee on Prevention of Obesity in Children and Youth. (2005). Preventing childhood obesity: Health in the balance: Executive summary. *Journal of the American Dietetic Association*, 105(1), 131–138.

Schwimmer JB, Burwinkle TM, Varni JW. Health-Related Quality of Life of Severely Obese Children and Adolescents. *JAMA*. 2003;289(14):1813-1819.

Fox CL, Farrow CV. Global and physical self-esteem and body dissatisfaction as mediators of the relationship between weight status and being a victim of bullying. *J Adolesc*. 2009;32(5):1287-1301.

Dietz WH. Health consequences of obesity in youth: childhood predictors of adult disease. *Pediatrics*. 1998;101(3 Pt 2):518-525.

Geier AB, Foster GD, Womble LG, McLaughlin J, Borradaile KE, Nachmani J, Sherman S, Kumanyika S, Shults J. The relationship between relative weight and school attendance among elementary schoolchildren. *Obesity (Silver Spring)*. 2007;15(8):2157-2161.

Heshmat R, Larijani FA, Pourabbasi A, Pourabbasi A. Do overweight students have lower academic performance than their classmates? A pilot cross sectional study in a middle school in Tehran. *J Diabetes Metab Disord*. 2014;13.

Biro FM, Wien M. Childhood obesity and adult morbidities. *Am J Clin Nutr*. 2010;91(5):1499S- 1505S.

Juonala M, Magnussen CG, Venn A, Dwyer T, Burns TL, Davis PH, Chen W, Srinivasan SR, Daniels SR, Kähönen M, Laitinen T, Taittonen L, Berenson GS,

Viikari JSA, Raitakari OT. Influence of age on associations between childhood risk factors and carotid intima-media thickness in adulthood: the Cardiovascular Risk in Young Finns Study, the Childhood Determinants of Adult Health Study, the Bogalusa Heart Study, and the Muscatine Study for the International Childhood Cardiovascular Cohort (i3C) Consortium. *Circulation*. 2010;122(24):2514-2520. doi:10.1161/CIRCULATIONAHA.110.966465.

Singh AS, Mulder C, Twisk JWR, van Mechelen W, Chinapaw MJM. Tracking of childhood overweight into adulthood: a systematic review of the literature. *Obes Rev*. 2008;9(5):474-488.

Weiss R, Dziura J, Burgert TS, Tamborlane WV, Taksali SE, Yeckel CW, Allen K, Lopes M, Savoye M, Morrison J, Sherwin RS, Caprio S. Obesity and the Metabolic Syndrome in Children and Adolescents. *New England Journal of Medicine*. 2004;350(23):2362-2374.

Hoelscher DM, Kirk S, Ritchie L, Cunningham-Sabo L, Academy Positions Committee. Position of the Academy of Nutrition and Dietetics: interventions for the prevention and treatment of pediatric overweight and obesity. *J Acad Nutr Diet*. 2013;113(10):1375-1394.

Medicine I of. *Preventing Childhood Obesity: Health in the Balance.*; 2004. <https://www.nap.edu/catalog/11015/preventing-childhood-obesity-health-in-the-balance>. Accessed November 11, 2016.

Healthy People 2020. <https://www.healthypeople.gov/2020/leading-health-indicators/2020-lhi-topics/Nutrition-Physical-Activity-and-Obesity/data>.

About Us | DNPAO | CDC. <http://www.cdc.gov/nccdphp/dnpao/division-information/aboutus/index.htm>.

State of Obesity - Moving Toward Modernizing Obesity Policies and Programs. <http://stateofobesity.org/policy/schools-and-healthy-weight/national-school-breakfast-and-lunch>- programs-and-related-school-nutrition-initiatives

Kleinman RE, Hall S, Green H, Korzec-Ramirez D, Patton K, Pagano ME, Murphy JM. Diet, breakfast, and academic performance in children. *Ann Nutr Metab*. 2002;46 Suppl 1:24-30. doi:66399.

Widenhorn-Müller K, Hille K, Klenk J, Weiland U. Influence of having breakfast on cognitive performance and mood in 13- to 20-year-old high school students: results of a crossover trial. *Pediatrics*. 2008;122(2):279-284

Murphy JM, Pagano ME, Nachmani J, Sperling P, Kane S, Kleinman RE. The Relationship of School Breakfast to Psychosocial and Academic Functioning:

Cross-sectional and Longitudinal Observations in an Inner-city School Sample. *Arch Pediatr Adolesc Med.* 1998;152(9):899-907.

Adolphus K, Lawton CL, Dye L. The effects of breakfast on behaviour and academic performance in children and adolescents. *Frontiers in Human Neuroscience.* 2013;7(10.3389/fnhum.2013.00425).  
<http://dx.doi.org/10.3389/fnhum.2013.00425>.

Deshmukh-Taskar PR, Nicklas TA, O'Neil CE, Keast DR, Radcliffe JD, Cho S. The Relationship of Breakfast Skipping and Type of Breakfast Consumption with Nutrient Intake and Weight Status in Children and Adolescents: The National Health and Nutrition Examination Survey 1999-2006. *Journal of the American Dietetic Association.* 2010;110(6):869-878.

Pereira MA, Erickson E, McKee P, Schrankler K, Raatz SK, Lytle LA, Pellegrini AD. Breakfast Frequency and Quality May Affect Glycemia and Appetite in Adults and Children. *J Nutr.* 2011;141(1):163-168.

Dubois L, Girard M, Potvin Kent M, Farmer A, Tatone-Tokuda F. Breakfast skipping is associated with differences in meal patterns, macronutrient intakes and overweight among pre-school children. *Public Health Nutrition.* 2009;12(1):19-28.

Kant AK, Andon MB, Angelopoulos TJ, Rippe JM. Association of breakfast energy density with diet quality and body mass index in American adults: National Health and Nutrition Examination Surveys, 1999-2004. *Am J Clin Nutr.* 2008;88(5):1396-1404.

Rampersaud GC, Pereira MA, Girard BL, Adams J, Metz J. Breakfast Habits, Nutritional Status, Body Weight, and Academic Performance in Children and Adolescents. *Journal of the American Dietetic Association.* 2005;105(5):743-760.

Affenito SG, Thompson DR, Barton BA, Franko DL, Daniels SR, Obarzanek E, Schreiber GB, Striegel-Moore RH. Breakfast Consumption by African-American and White Adolescent Girls Correlates Positively with Calcium and Fiber Intake and Negatively with Body Mass Index. *Journal of the American Dietetic Association.* 2005;105(6):938-945.

Williams BM, O'Neil CE, Keast DR, Cho S, Nicklas TA. Are breakfast consumption patterns associated with weight status and nutrient adequacy in African-American children? *Public Health Nutrition.* 2009;12(4):489-496.

McCrary MA, Campbell WW. Effects of Eating Frequency, Snacking, and Breakfast Skipping on Energy Regulation: Symposium Overview. *J Nutr.*

2011;141(1):144-147.

Szajewska H, Rusczyński M. Systematic Review Demonstrating that Breakfast Consumption Influences Body Weight Outcomes in Children and Adolescents in Europe. *Critical Reviews in Food Science and Nutrition*. 2010;50(2):113-119.

Gleason PM, Dodd AH. School Breakfast Program but Not School Lunch Program Participation Is Associated with Lower Body Mass Index. *Journal of the American Dietetic Association*. 2009;109(2, Supplement):S118-S128.

O'Neil C.E., Byrd-Bredbenner C., Hayes D., Jana L., Klinger S.E., Stephenson-Martin S. The role of breakfast in health: Definition and criteria for a quality breakfast. *J. Acad. Nutr. Diet.* 2014;114:S8–S26.

Lytle LA, Seifert S, Greenstein J, McGovern P. How do children's eating patterns and food choices change over time? Results from a cohort study. *Am J Health Promot.* 2000;14(4):222-228.

Anand J, Goldman JD, Steinfeldt LC, Montville JB, Heendeniya KY, Omolewa-Tomobi G, Enns CW, Ahuja JK, Martin CL, LaComb RP, Moshfegh AJ. 2012. What we eat in America, NHANES 2009–2010: documentation and data files. Worldwide Web Site: Food Surveys Research Group.

Basch CE. Breakfast and the achievement gap among urban minority youth. *J Sch Health*. 2011;81(10):635-640.

Agostoni, C., Brighenti, F. **Dietary choices for breakfast in children and adolescents.** *Crit Rev Food Sci Nutr*. 2010;50:120–128.

Ask AS, Hernes S, Aarek I, Johannessen G, Haugen M. Changes in dietary pattern in 15-year-old adolescents following a 4 month dietary intervention with school breakfast – a pilot study. *Nutr J* 2006; 5: 33.

Albertson, A.M., Wold, A.C., Joshi, N. **Ready-to-eat cereal consumption patterns: The relationship to nutrient intake, whole grain intake, and body mass index in an older American population.** *J Aging Res*. 2012;2012:631310.

Barton BA, Eldridge AL, Thompson D, Affenito SG, Striegel-Moore RH, Franko DL, Albertson AM, Crockett SJ. The Relationship of Breakfast and Cereal Consumption to Nutrient Intake and Body Mass Index: The National Heart, Lung, and Blood Institute Growth and Health Study. *Journal of the American Dietetic Association*. 2005;105(9):1383-1389.

Crossman, A., Anne Sullivan, D., Benin, M. **The family environment and American adolescents' risk of obesity as young adults.** *Soc Sci Med*. 2006;63:2255–2267.

Elgar FJ, Roberts C, Moore L, Tudor-Smith C: Sedentary behaviour, physical activity and weight problems in adolescents in Wales. *Public Health*. 2005, 119 (6): 518-24.

Merten MJ, Williams AL, Shriver LH. Breakfast Consumption in Adolescence and



Young Adulthood: Parent Presence, Community Context, and Obesity. *Journal of the American Dietetic Association*. 2009;109(8):1384-1391.

Timlin MT, Pereira MA, Story M, Neumark-Sztainer D. Breakfast Eating and Weight Change in a 5-Year Prospective Analysis of Adolescents: Project EAT (Eating Among Teens). *Pediatrics*. 2008;121(3):e638-3645.

Affenito SG. Breakfast: A Missed Opportunity. *Journal of the American Dietetic Association*. 2007;107(4):565-569.

Tin SP, Ho SY, Mak KH, Wan KL, Lam TH. Breakfast skipping and change in body mass index in young children. *Int J Obes (Lond)* 2011; **35**: 899–906.

Keski-Rahkonen A, Kaprio J, Rissanen A, Virkkunen M, Rose RJ. Breakfast skipping and health-compromising behaviors in adolescents and adults. *Eur J Clin Nutr*. 2003;57(7):842-853.

Dialektakou KD, Vranas PBM. Breakfast Skipping and Body Mass Index among Adolescents in Greece: Whether an Association Exists Depends on How Breakfast Skipping is Defined. *Journal of the American Dietetic Association*. 2008;108(9):1517-1525.

Veltista. Relationship between Eating Behavior, Breakfast Consumption, and Obesity Among Finnish and Greek Adolescents.

Baldinger N, Krebs A, Muller R, Aeberli I. Swiss children consuming breakfast regularly have better motor functional skills and are less overweight than breakfast skippers. *J Am Coll Nutr*. 2012;31(2):87–93.

Warren JM, Henry CJK, Simonite V. Low glycemic index breakfasts and reduced food intake in preadolescent children. *Pediatrics*. 2003;112:414–19

Baxter SD, Thompson WO, Davis HC, Johnson MH. Impact of gender, ethnicity, meal component, and time interval between eating and reporting on accuracy of fourth-graders' self-reports of school lunch. *J Am Diet Assoc* 1997; **97**: 1293–1298.

Kontogianni MD, Farmaki AE, Vidra N, Sofrona S, Magkanari F, Yannakoulia M: Associations between lifestyle patterns and body mass index in a sample of Greek children and adolescents. *J Am Diet Assoc*. 2010, 110: 215-221.

School Meals. Nutrition Standards for School Meals.

<http://www.fns.usda.gov/school-meals/nutrition-standards-school-meals>.

Child Nutrition Reauthorization: Healthy, Hunger-Free Kids Act of 2010. (2010). Retrieved from

[http://www.whitehouse.gov/sites/default/files/Child\\_Nutrition\\_Fact\\_Sheet\\_12\\_10\\_10.pdf](http://www.whitehouse.gov/sites/default/files/Child_Nutrition_Fact_Sheet_12_10_10.pdf)

Federal Register. (2012). Nutrition Standards in the National School Lunch and School Breakfast Programs; Final Rule. 77(17). Retrieved from

<http://www.gpo.gov/fdsys/pkg/FR-2012-01-26/pdf/2012-1010.pdf>

Food Research and Action Center: The School Breakfast Program. Food Research and Action Center. [http://frac.org/wp-content/uploads/2009/09/school\\_breakfast\\_program\\_fact\\_sheet.pdf](http://frac.org/wp-content/uploads/2009/09/school_breakfast_program_fact_sheet.pdf)

Story, M. (2009). The Third School Nutrition Dietary Assessment Study: Findings and policy implications for improving the health of US children. *Journal of the American Dietetic Association*, 109(2 Suppl), S7-S13

Olsho LE, Fernandes MM (2013) [Relationship of white potato to other vegetable consumption by schoolchildren and adolescents in the USA: National Health and Nutrition Examination Survey, 2003-2008. Public Health Nutr 16: 1933-1936.](#)

Centers for Disease Control and Prevention. Strategies to Prevent Obesity and Other Chronic Diseases: The CDC Guide to Strategies to Increase the Consumption of Fruits and Vegetables. Atlanta: U.S. Department of Health and Human Services; 2011.

Briggs, M., Mueller, C.G., & Fleischhacker, S. (2010). Position of the American Dietetic Association, School Nutrition Association, and Society for Nutrition Education: Comprehensive school nutrition services. *Journal of the American Dietetic Association*, 110(11), 1738-1749.

Winterfeld A. State Actions To Reduce And Prevent Childhood Obesity In Schools and Communities: Summary and Analysis of Trends in Legislation (2014).

National Farm To School Network. <http://www.farmentoschool.org/>

Anupama J. Do Farm To School Programs Make A Difference? Findings and future research needs. [http://www.cahpf.org/GoDocUserFiles/504.Farm\\_to\\_School\\_Programs.pdf](http://www.cahpf.org/GoDocUserFiles/504.Farm_to_School_Programs.pdf)

Children eating more fruit, but fruit and vegetable intake still too low. <http://www.cdc.gov/media/releases/2014/p0805-fruit-vegetables.html>.

The Food Trust. Farm to School. <http://thefoodtrust.org/what-we-do/schools/farm-to-school>.

LaRowe, T. L., Bontrager Yoder, A., Knitter, A., Meinen, A., Liebhart, J. L. & Schoeller, D.(n.d.) Wisconsin farm-to-school one year evaluation report. Wisconsin Prevention of Obesity and Diabetes, University of Wisconsin-Madison. A Joshi, MM Ratcliffe. Causal pathways linking farm to school to childhood obesity prevention. *Child Obes.* 2012;8(4):305–314.

Stables GJ, Young EM, Howerton MW, Yaroch AL, Kuester S, Solera MK, Cobb K, Neveling L. Small schooled based effectiveness trials increase vegetable and fruit consumption among youth. *J Am Diet Assoc.* 2005;105(2):252-256.

Knai C, Pomerleau J, Lock K, McKee M. Getting children to eat more fruit and vegetables; a systematic review. *Prev Med.* 2006;42(2):85-95.

Helena C Lyson. National policy and state dynamics: A state-level analysis of the factors influencing the prevalence of farm to school programs in the United States. *Food Policy*.

Berlin L, Norris K, Kolodinsky J, Nelson A. The role of social cognitive theory in farm to school related activitiesL implications for child nutrition. *J Sch Health*. 2013;83(8):589-595.

Vericker TC. Children's School Related Food and Physical Activity Behaviors are Associated with Body Mass Index. *Journal of the Academy of Nutrition and Dietetics*. 2014;114(2):250-256.

## **APPENDIXES**

**Appendix A**  
**Summary of research analyzed for review**

Author/Year	Population	Methods	Results	Conclusions
Keski-Rahkonen /2003	16 yo n= 5448 Parents n= 4660	Self-report questionnaire  Questions such as: How often do you eat breakfast (for example, sandwiches, milk, hot cereal, other similar food) before going to school or work?" and asked subjects to answer "every morning", "a few times a week", or "about once a week or less often"	P<0.001  P<0.001  P<0.001  P<0.001  P<0.001  P<0.001  P<0.001  P<0.001  P<0.001  P<0.001	High body mass index ( $\geq 25$ ) is associated with breakfast skipping  Infrequent exercise is correlated with adolescents; Exercise 1-2x/month and breakfast skipping: OR 2.33 (1.66-3.28CI)  Exercise less than 1x/month and breakfast skipping: OR 4.03 (2.84-5.72CI)  Exercise 0x/month and breakfast skipping: OR 3.75 (2.57-5.47CI)  Parental breakfast habits are significantly associated with children's breakfast habits  Breakfast skippers are more likely to consume alcohol, caffeine, and cigarettes (adjusted multinomial logistic regression) Alcohol (weekly use): OR: 2.89 (2.1-4.0) Caffeinated soda (1+ bottle/day): OR 2.1 (1.5-2.9) Cigarettes (daily): OR 4.17 (3.34-5.2)  Girls consumed daily breakfast 68.4% Boys consumed breakfast 73.5%
Dialektakou/2008	n= 811 383 boys 429 girls 14-21 yo  <b>Mean age:</b> 16.62 <b>Mean BMI:</b> 23.10 <b>% of overweight and obesity:</b> 28.1%	Anonymous questionnaires' distributed in classrooms.  Investigators weighed and measured participants with a digital scale and stadiometer. Height and weight was recorded on corresponding questionnaire.  Compared BMI and overweight/obesity with 24 definitions of breakfast skipping.	P<0.05  P<0.05	Significant association between breakfast skipping and BMI was found in 29 of 48 linear regression models  Significant association between breakfast skipping and overweight/obesity was found in 35 of 48 models used  Association of breakfast skipping and overweight/obese status, varied by definitions of breakfast skipping

Veltsista /2010	n=6468 16-18yo	Mail surveys were dispersed among subjects. Breakfast habits, weight control methods, dietary habits, height, and weight were accessed.  Breakfast consumption was grouped into four categories; A: daily B: 1-3 times/week C: 1-3 times/month D: never/rarely	P<0.001	Males, but not females, who consumed breakfast were at higher risk of overweight/obesity  OR and 95% CI of overweight/obesity Daily breakfast Finnish boys: 0.60 (0.46-0.78) Greek boys: 0.72 (0.54-0.95) Greek girls: 1.01 (0.75-1.37) Greek girls: 1.01 (0.75-1.37)
Timlin /2008	n=2216  mean age at time of EAT-I = 14.9  mean age at time of EAT-II = 19.4	EAT-I survey, a 221 item self-report addressing behavior, socioenvironmental, and personal information.  Height and weight measured by research staff  EAT-II survey, five years following EAT-I assessed changes in eating behavior and weight status.	P<0.01  P<0.01  P<0.05	Among sample, 27.2% of girls and 31.2% of boys consumed daily breakfast at time of EAT-I. At time of EAT-II, 21.2% of boys consumed daily breakfast.  Participants who were either Caucasian or African American and who were engaged in higher levels of physical activity were more likely to consume daily breakfast.  A higher BMI was observed in participants who did not consume breakfast or ate breakfast intermittently. Significance remained after adjusting for age, gender, race, SES, exercise, and alcohol/liquor use (model 1). Significance remained after adjusting for socioeconomic factors in model 1 and adjusting for the above items (model 2). Significance remained after adjusting for psychosocial variables, weight control behaviors, and exercise in addition to adjustments in model 2.  Over the 5 year period, regular breakfast consumption was associated with lower BMI increases. After adjusting for gender, race, SES, exercise, cigarette use, and alcohol use, breakfast consumers had an average BMI increase of 0.6 ± 0.19, while intermittent breakfast eaters had an average BMI increase of 1.0 ± 0.19.
Merten /2009	n=7788 National Longitudinal Study of Adolescent Health  12-19yo at wave 2 18-26yo at wave 3	Subjects recruited from 134 middle and high schools. 74.8% Caucasian, 25.2% African American.  Community disadvantage, family poverty, parental presence in mornings, regular breakfast consumption, height, weight, and demographics were assessed at wave 2 and 3. Data were collected from US census, survey, and self-reported anthropometrics.	P<0.001  P<0.001	Higher levels of community disadvantage were associated with the likelihood of adolescent breakfast consumption [OR] 0.85; 95% confidence interval 0.75-0.96. Breakfast consumption in adolescence was associated with a lower likelihood of chronic obesity (OR 0.34 to 0.48).  Consuming frequent breakfast, defined as eating breakfast at least 5 times per week in adolescence as well as young adulthood, was associated with a lower likelihood of chronic obesity than not consuming breakfast frequently in adolescence and young adulthood (OR CI: 0.34 to 0.48).

Affenito /2005	n=2379 Girls aged 9-10 at study start	9 year- longitudinal biracial cohort study by the National Heart, Lung, and Blood Institute Growth and Health Study.  3 day annual food records collected by interview.  Annual height and weight recorded by trained examiners.	P<0.05  P<0.0001 P<0.0001 P<0.001	Number of days of breakfast consumption was a significant predictor of BMI ( $\chi^2 [1] = 14.05$ ). This was true for location, race, age, race-by-age, and sex.  When parental education and physical activity were controlled well, breakfast behavior did not significantly predict BMI. Parental education $\chi^2 [1] 16.06$ P<0.001 Physical activity $\chi^2 [1] 21.00$ P<0.001 Energy intake $\chi^2 [1] 12.03$ P<0.01
Deshmukh-Taskar /2010	n=4320 9-10yo  n=5339 14-18yo	Self-reported breakfast consumption patterns and anthropometric data from NHANES records 1999-2006.  Dietary recalls achieved from single multipass 24h recall.  Weight, height, and waist circumference were measured by NHANES professionals in the Mobile Examination Center.	P<0.05  P<0.05  P<0.05	20% of children and 31.5% of adolescents were breakfast skippers.  Mean adequacy ratio (MAR) was higher for cereal consumers and other breakfast consumers than breakfast skippers.  Children who classified as breakfast skippers had lower scores for age than other breakfast consumers.  Child breakfast skippers had higher weight and BMI than cereal and other breakfast consumers.
Szajewska /2010		16 cross-sectional or cohort trials involving more than 59,000 children/adolescents from Europe		Thirteen studies (n = 57,481) consistently found that breakfast consumption has a protective effect against becoming overweight.  The effect of eating breakfast on the risk of becoming overweight was analyzed in 4 studies (n = 2897). Breakfast consumption was associated with lower BMIs.
Dubois /2008	n=1549 average age= 49mo	Children and parents were seen at 5 months of age and one year intervals following.  Questionnaires, interviews, and anthropometric data was accessed at each visit.	P<0.05  P<0.05  P<0.05  P<0.05  P<0.05	10% of children at breakfast fewer than 10% of children at breakfast.  Breakfast skippers consumed fewer grams of protein and fat than breakfast eaters.  Breakfast skippers consumed more kilocalories than breakfast eaters. And more carbohydrates in their diet.  Breakfast skippers consumed less vegetables and fruits. OR: 1.14, 1.24 SEM: .046, .016 respectively  Breakfast skippers consumed less grains. OR: 3.93, 4.09 SEM: .071, .024 respectively  Breakfast skippers consumed less milk. OR: 1.77, 1.98 SEM: .059, .025 respectively  Breakfast skipping and body weight: Model 1: breakfast skippers were twice as likely to be overweight than breakfast consumers. Model 2: After adjustment for energy intake, breakfast skipping even more so significantly associated with overweight/obesity.

Baldinger /2012	n=656 7-10yo	Self-reported nutrition survey reflective of eating habits, specifically of breakfast/morning snack at school.  Anthropometric measurements taken by research team.  Five standardized motor function tests; sidewise jumping, tapping, standing long jump, 20-m sprint, and shuttle run.	P<0.05  P<0.05	Children consuming breakfast almost daily had lower BMI ( $16.7 \pm 2.2 \text{ kg/m}^2$ ) compared to children consuming breakfast only sometimes or almost never ( $18.8 \pm 3.4 \text{ kg/m}^2$ , respectively).  Children consuming breakfast had better motor function in 3 of the 5 tests.
Kontogianni /2020	n=1305 3-18yo	Telephone interviews. Sample selection multistage, stratified, and random.  Self-stated information on anthropometrics, dietary intake and eating behavior, and physical activity.	P<0.01  P<0.001	Breakfast consumption and higher KIDMET scores were associated with BMI whole sample: standard deviation = 1.2. Acceptable energy reporters: standard deviation = 1.2.
Warren /2013	n=37 9-12yo	3-way crossover study  5 groups were devised whereby, week by week, each group would randomly receive 1 of 3 test breakfasts for 3 consecutive days, with a minimum of 5 weeks between the test breakfasts. 3 breakfasts include low-glycemic index (GI), low-GI +10% sucrose, and high-GI.  Breakfasts were composed of fruit juice, cereal, and milk with and without bread.  Children were directed to abstain from eating until lunchtime except water and one small fruit serving.  Lunch, buffet style, was assessed by research team and analyzed to type of breakfast consumed.	P<0.05	The type of breakfast eaten had a statistically significant effect on mean energy intake at lunchtime.  Lunch intake was significantly higher for the high-GI breakfast.  Caloric differences between test breakfasts: high-GI versus low-GI = $145 \pm 54 \text{ kcal}$ ; high-GI versus low-GI plus sucrose = $105 \pm 54 \text{ kcal}$ ; low-GI plus sucrose versus low-GI = $105 \pm 54 \text{ kcal}$ .  No difference was found between breakfasts for the low-GI plus sucrose group.
Barton /2005	n=2379 9-10yo	9 year- longitudinal biracial cohort study by the National Heart, Lung, and Blood Institute Growth and Health Study.  3 day annual food records collected by interview.  Annual height and weight recorded by trained examiners.	P<0.0001  P<0.0001	Days eating cereal was predictive of BMI [repeated-measures Mantel-Haenszel test: $\chi^2(10)=1,603.09$ ].  Frequency of breakfast and cereal consumption were predictive of BMI by age.



Williams /2008	n=1389 1-12yo	Data from NHANES 1999-2002.  Dietary recalls achieved from single multipass 24h recall.  Weight, height, and waist circumference were measured by NHANES professionals in the Mobile Examination Center.	P<0.05 P<0.05	The lowest mean BMI and mean waist circumference were observed in children 1–12 years of age who consumed 100% juice compared with other consumption groups.  No differences in percentiles or Z-scores for weight-for-age were observed between consumption groups in children.
Hunty/2013		14 research papers.	P<0.0001	The computed effect size for mean BMI was small for consumers and low or non-consumers over all 2 studies (-0.81, -1.46) kg/m <sup>2</sup> (95% CI -0.81, -1.46)  Adjustment for age and publication bias was made, but they remained statistically significant.

## Appendix B

### *SBP Regulations Following the HFFKA*

#### Breakfast Meal Pattern Grade K-5

##### Amount of food per week (minimum per day)

Fruits (cups)	5 (1)
Vegetables	0
Addition Veg to Reach Total	0
Grains (oz eq)	7-10 (1)
Meats/Alternatives	0
Fluid milk (cups)	5 (1)
Min-max (kcal)	350-500
Saturated fat (% of total kcal)	<10
Sodium	<430

Trans fat Nutrition Label or manufacturer specifications must indicate zero grams of trans fat per serving.

Adapted from the Federal Register (2012) Nutrition Standards in the National School Lunch and School Breakfast Programs; Final Rule; and USDA. Exceptions to SBP: at breakfast only, vegetables may be served in place of fruits Schools may substitute meat/meat alternate for grains once daily grains alternate for grains once daily grains minimum is met. Milk options must be low fat (unflavored) or fat free (flavored or unflavored).