

**IMPACT OF THE *B'MORE HEALTHY COMMUNITIES FOR KIDS*  
INTERVENTION ON DIET AND FOOD-RELATED BEHAVIORS  
AMONG LOW-INCOME URBAN AFRICAN AMERICAN  
YOUTH AND THEIR ADULT CAREGIVERS**

by

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## Abstract

**Background:** Consumption of foods and beverages rich in sugar, fat, and salt remains high across all races and ages in the United States. In view of the multifactorial etiology of weight gain, efforts that simultaneously address multiple levels of the food system are recommended that will impact on food selection and consumption. Thus, multilevel multicomponent interventions to address childhood obesity and improve food-related behaviors and intake are needed, particularly in low-resource settings. It is also important to test whether community interventions are effective in ‘real-world’ conditions and in hard-to-reach populations, as participants need to have sufficient exposure to the intervention.

**Objective:** To evaluate how a multilevel multicomponent childhood obesity prevention intervention impacted the diet and food-related behaviors of low-income urban, predominantly African American families living in neighborhoods with low access to healthy foods in Baltimore City, and to evaluate the patterns of exposure to the different components of the intervention.

**Methods:** B’more Healthy Communities for Kids (BHCK) was a group-randomized controlled trial in 30 low-income areas in Baltimore for 534 African American youth aged 9-15 years old. BHCK components (policy, wholesaler, small stores, youth-mentor led nutrition education, and social media) simultaneously promoted purchase and consumption of low-sugar, low-fat foods/beverages. Exposure to the different intervention components was assessed via post-intervention interviews with 385 youths and their adult caregivers. Exposure scores were generated based on self-reported viewing of BHCK materials and participating in activities. Food consumption in youth

(n=357) was assessed pre/post-intervention using the Block Kids Food Frequency Questionnaire. Analyses were stratified by age (school-age: 9-12; adolescent: 13-15). Additionally, caregivers' (n=516) self-reported household food acquisition frequency for food items over 30 days, and usual consumption of fruit and vegetable (FV) was assessed in a sub-sample of 226 caregivers via the NCI FV Screener. Hierarchical multilevel models were conducted with random effects at the community and individual levels and assessed average-treatment-effects (ATE). Treatment-on-the-treated-effect (TTE) analyses evaluated the correlation between behavioral change and exposure to BHCK among adults.

**Results:** The BHCK intervention group was more exposed to the program components, and the comparison group also received some exposure, though to a lesser degree. In ATE analysis, youth in the intervention group purchased almost 1.5 more healthier food/beverage items per week, compared to their counterparts ( $\beta = 1.4$ ; 95% CI: 0.1; 2.8). The age-stratified analysis demonstrated that BHCK decreased kcal intake from sweet snacks among intervention adolescents (13-15 years old) by 3.5% compared to their counterparts ( $\beta = -3.5$ ; 95% CI: -7.76; -0.05). No significant effect of the intervention was found on caregiver food-related behaviors in the ATE analysis. However, the TTE showed a statistically significant increase in daily intake of fruits by 0.2 servings among adult participants who reported higher exposure to the intervention ( $0.2 \pm 0.1$ ; 95% CI 0.1; 0.5). Caregivers reporting greater exposure to social media tripled their daily fruit intake ( $3.1 \pm 0.9$ ; 95% CI 1.3; 4.9), compared to baseline.

**Conclusions:** Multilevel, multicomponent environmental childhood obesity programs are a promising strategy to improve eating behaviors among low-income urban youth. Child-

focused community-based nutrition interventions may also benefit family members. Future community-based environmental intervention trials targeting low-income populations may consider enrolling larger sample sizes and improving program intensity, as the likelihood of low exposure is high. Future multilevel studies should consider using social media to improve reach and engage caregiver participants.

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## **List of terms and abbreviations**

<b>AIQ</b>	Adult Impact Questionnaire
<b>ATE</b>	Average treatment effect
<b>BHCK</b>	B'more Healthy Communities for Kids
<b>BHEZ</b>	Baltimore Healthy Eating Zones
<b>BKFFQ</b>	Block Kids 2004 Food Frequency Questionnaire
<b>BMI</b>	Body Mass Index
<b>CIQ</b>	Child Impact Questionnaire
<b>CI</b>	Confidence interval
<b>FV</b>	Fruits and vegetables
<b>GH</b>	Growth hormone
<b>GIS</b>	Geographic Information System
<b>GnRH</b>	Gonadotropin-releasing hormone
<b>HFAI</b>	Healthy Food Availability Index
<b>IGF-1</b>	Insulin-like growth factor-1
<b>IEQ</b>	Intervention Exposure Questionnaire
<b>MLMC</b>	Multilevel Multicomponent
<b>NCI</b>	National Cancer Institute
<b>NHANES</b>	National Health and Nutrition Examination Survey
<b>NSLP</b>	National School Lunch Program
<b>SD</b>	Standard deviations
<b>SE</b>	Standard error
<b>SSB</b>	Sugar Sweetened Beverages
<b>SUS</b>	Shape Up Somerville
<b>TTE</b>	Treatment-on-the-treated effect
<b>WIC</b>	Special Supplemental Nutrition Program for Women, Infants, and Children

# **Chapter 1. Introduction**

## ***1.1 Study Objectives***

Obesity, one of the biggest public health challenges worldwide, disproportionately affects low-income urban communities of color.<sup>1</sup> Diets of American youth and adults are often characterized by high intakes of refined carbohydrates, added sugars, fats, and salt due to high consumption of energy dense, processed foods, and very low intake of low-calorie, health promoting, fiber-rich fruits and vegetables.<sup>2</sup>

In order to improve dietary patterns within a population, nutrition interventions need to focus not only on the individual level, but also on the environmental context that affects individual eating behavior. The multifactorial causes of obesity are well-recognized, and it is clear that no single community program or policy provides a comprehensive solution.<sup>3,4</sup> Nutritional education alone is limited, particularly in settings where the food and built environments are restricted, such as in low-income urban settings where healthy choices are not accessible. Thus, individual behavior change is more likely to occur and be sustained if the environment is conducive to an adoption of healthy food choices accompanied by educational strategies. Most randomized controlled trials aiming to prevent childhood obesity have been primarily school-based and have shown mixed results.<sup>5</sup> One possible explanation for these mixed results is differential access to healthy and unhealthy food outside of the school environment across income groups.

Low-income African American populations in the U.S. often live in food environments that promote unhealthy food choices and lack healthier foods. As such,

these populations experience higher rates of food insecurity and are at a greater risk of consuming inadequate diets, making them more susceptible to obesity and other diet-related chronic diseases. Higher obesity rates occur among this population because they may undergo cyclic periods of food deprivation and overeating, and are subject to limited physical and financial access to nutritious food.<sup>6,7</sup> Access to healthful food also plays an important role in food security, diet quality, and health outcomes; however, few community-based childhood prevention trials have worked at multiple levels to improve the community food environment. Despite initial advances, little is known about how best to improve the dietary intake of low-income minority youth in low-resource settings where the food environment is of poor quality and food insecurity is predominant. Furthermore, few multilevel community-based childhood obesity prevention trials have considered individual, environmental, media and policy strategies<sup>8</sup>, and insufficient evaluation of their impact on diet and food behaviors in child and their caregivers exists.<sup>9</sup> In addition, little is known about how best to reach underserved populations in community-based interventions, and how much dose of the program should be delivered for behavior change.<sup>10</sup>

The B'more Healthy Community for Kids (BHCK) was a community-based group randomized intervention trial which targeted multiple levels of the urban food environment to improve healthy food access, purchase, and consumption through interventions carried out at the individual, peer-mentor, small food source (corner store and carryout restaurants), wholesale, and policy levels.<sup>11</sup> The social-ecological model and the social cognitive theory guided the principles of this multilevel trial, as BHCK

recognized that a dynamic interplay exists among individual, social, and environmental systems, to influence health and behavioral outcomes.

The overarching goal of this proposal is to conduct a sub-analysis of the BHCK intervention to evaluate how a multilevel, multicomponent obesity prevention intervention impacts dietary and food-related behaviors of low-income urban, predominantly African American families living in neighborhoods with low access to healthful foods in Baltimore City.

The specific research aims of this study are:

**Research Aim 1** - To evaluate the patterns and determinants of exposure ('dose received') to BHCK materials and activities among youth and their caregivers.

**Research Aim 2:** To evaluate the impact of the BHCK intervention trial on food consumption, preparation, and acquisition among low-income urban African American youth.

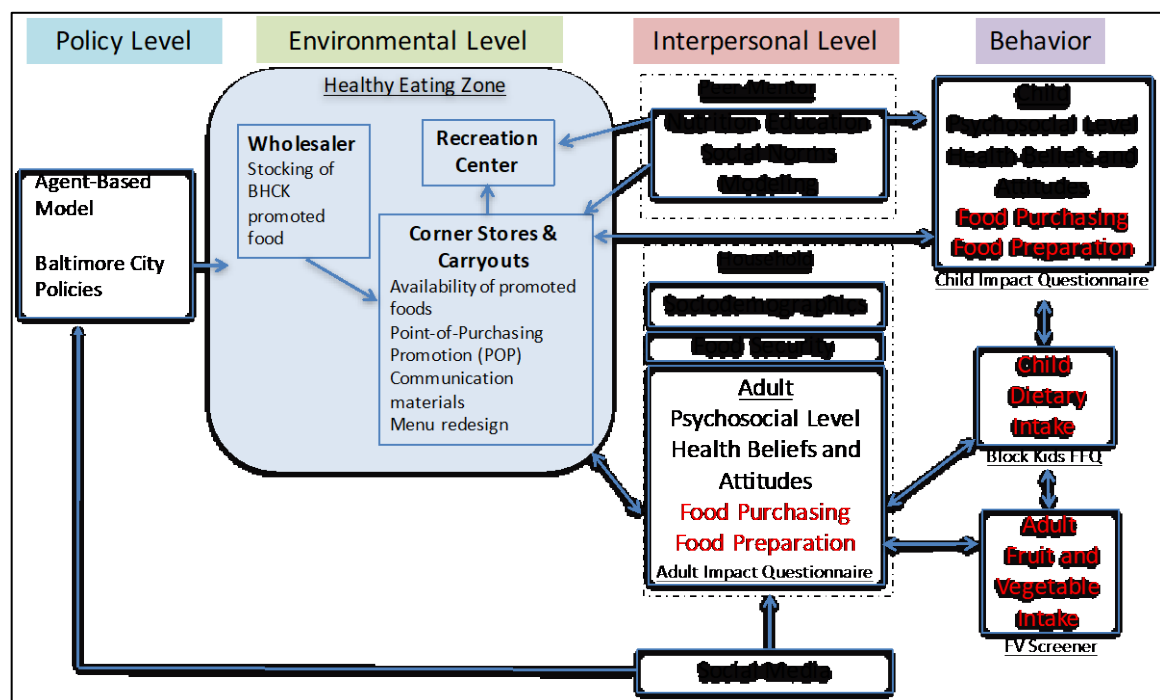
**Research Aim 3** - To evaluate the impact of the BHCK intervention trial on fruit and vegetable intake, food preparation, and acquisition among low-income urban African American caregivers.

## ***1.2 Conceptual Framework***

The B'more Healthy Communities for Kids (BHCK) intervention worked in four levels of the socioecological model – policy, environmental, interpersonal and intrapersonal – as well as in multiple components of the food system, involving wholesalers, small food stores, after-school programs (recreation centers), peer-mentor led nutrition education, and the information environment (social media) (**Figure 1.1**). BHCK used social modeling and observational learning principles rooted in the social



cognitive theory to improve knowledge, self-efficacy, and intentions to healthy eating of youth and their caregivers and to create demand for healthy foods at small food retail stores.<sup>12-14</sup> BHCK was implemented with integrated strategies that connected the different components of the food environment. For instance, BHCK worked with corner store and carryout restaurant owners/managers nearby intervention recreation centers to implement environmental changes to promote healthy food choices for the community. Concomitantly, peer mentors led nutrition education with youth in the nearby recreation centers to improve demand for healthier foods. Finally, a systems approach was implemented to connect each level of the food supply chain and included wholesalers stocking the foods being promoted by the program, as well as Baltimore policymakers utilizing evidence from the program in support of their agenda to improve the city's food environment.



**Figure 1.1:** Conceptual framework of the multilevel multicomponent B'more Healthy Communities for Kids intervention on consumption and food-related behaviors among youth and their caregivers.

The conceptual framework above depicts the main pathways by which BHCK was hypothesized to influence food-related behaviors and consumption among youth and their caregivers. For instance, it was hypothesized that youth living in intervention neighborhoods - where corner stores and carryout restaurants stocked and promoted healthier foods and nutrition education was delivered by mentors in nearby recreation centers – would have healthier food purchasing, preparation, and dietary intake behaviors than youth living in comparison neighborhoods. Similarly, it was hypothesized that their adult caregivers would have improved food-related behaviors and fruit and vegetable intake in part due to the environmental changes of the BHCK intervention and educational activities through social media and texting, and to exposure to communication materials (i.e., flyers, giveaways) that were brought home by their youth attending BHCK activities. It is also possible that youth and caregivers would reinforce positive and healthier food-related behaviors at the household-level, thus influencing one another. Secondly, it was also hypothesized that individuals who engaged more with BHCK community activities and/or were more exposed to the communication and promotional materials during the intervention would have improved food-related and dietary behaviors at the end of the program compared to baseline.

### ***1.3 Organization of the Dissertation***

This dissertation is organized in seven chapters, beginning with this introduction. The second chapter (**Chapter 2**) presents a comprehensive review of the literature on the burden of obesity among children and adults in the United States and in Baltimore, the influence of individual, family, and environmental factors on obesity, diet, and food-related behaviors, and discusses previous multilevel, multicomponent childhood obesity prevention interventions in developed countries, gaps in this previous work, and how the current trial addressed these gaps. The third chapter (**Chapter 3**) describes in detail the methods utilized for this dissertation work, including a description of the parent study - *B'more Healthy Communities for Kids* – in terms of design, setting, recruitment, implementation, data collection instruments, formation of variables, data analyses for each of the three aims of this dissertation, and ethical considerations.

**Chapter 4** (Paper 1) identifies the patterns and determinants of the different levels of exposure to the B'more Healthy Community for Kids (BHCK) intervention. A detailed development of an exposure score ('dose received') is presented. The analyses revealed the extent to which participants recruited for the evaluation of a multilevel intervention were actually exposed to the intervention. There was contamination in the comparison group that might attenuate the treatment effects in future average treatment effect analyses. Thus, a case for future community-based interventions to enroll larger sample sizes, and for a secondary impact analysis utilizing a treatment-on-the-treated effect approach are discussed. This paper was published in *Trials* (2018)

<https://doi.org/10.1186/s13063-018-2663-y>.

**Chapter 5** (Paper 2) describes the impact evaluation of the B'more Healthy Communities for Kids intervention on youth's food purchasing and consumption. This study utilized hierarchical linear regression models and employed an average-treatment-effect approach. This manuscript is currently under review at the *Nutrition Journal*.

**Chapter 6** (Paper 3) presents the impact results of the B'more healthy Communities for Kids intervention on youth's adult caregivers in terms of food purchasing, preparation, and fruit and vegetable intake. Hierarchical models assessed average-treatment-effects, where no significant effect of the intervention was found on caregiver food-related behaviors. Treatment-on-the-treated-effect analyses evaluated the correlation between behavioral change and exposure to BHCK, utilizing the methods presented in Paper 1. This paper is currently in press at *Public Health Nutrition*.

Lastly, **chapter 7** concludes this dissertation by summarizing the main results in relation to the study aims and discusses the strengths and limitations of the research. The chapter concludes with recommendations for future research, theory development and policy for improving healthier eating practices among youth and their families living in low-resource settings.

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## **Chapter 2. Literature review**

This chapter reviews the literature relevant to this dissertation. The literature review begins with an overview of the public health problem that overweight and obesity poses on children and adults in the United States and in Baltimore specifically, followed by the physiological developmental phase of adolescence and their nutritional needs. Then, a discussion of the multifaceted causes of child and adult obesity is provided, organized by the multiple levels of the socioecological model (individual, household, and environmental factors), followed by an overview of the most utilized social and behavioral theories in obesity intervention research - the social cognitive theory and the socioecological model. The chapter concludes with a comprehensive review of previous childhood obesity prevention interventions tested in developed countries and the current gaps in the literature pertaining to adolescent and adult food-related behaviors, followed by a description of the work that informed the *B'more Healthy Communities for Kids* intervention trial.

### ***2.1 Childhood and Adult Obesity in the United States***

Obesity is a chronic and inflammatory state caused by an imbalance between energy ingested and energy expended that results in an excessive accumulation of body fat. Obesity is defined by the distribution of body fat in the body, and is commonly measured by the Body Mass Index (BMI) calculated by the ratio of height and weight of an individual. In adults, a BMI above 25kg/m<sup>2</sup> is considered risk for overweight and above 30kg/m<sup>2</sup> for obesity. In children, a BMI above the 85<sup>th</sup> percentile of the sex-specific Centers for Disease Control and Prevention (CDC)<sup>15</sup> growth charts is considered

a risk for overweight and at or above the 95<sup>th</sup> percentile for obesity. Both adult and child BMI cut off points have been associated with increased risk for cardiovascular disease, diabetes, and other health outcomes.<sup>16</sup>

Childhood obesity is a significant public health problem, with one-third of U.S. children being overweight or obese.<sup>1,17,18</sup> However, disparities exist according to geography, sex, age, education, race, and income.<sup>19,20</sup> For instance, the highest rate of obesity has been found among residents of neighborhoods with fewer resources for healthy foods, physical activity, and higher economic deprivation levels.<sup>21-24</sup> Data from the 2011-2012 NHANES (National Health and Nutrition Examination Survey) showed the prevalence of obesity in youth was significantly higher among Hispanic American (22.4%) and African American youth (20.2%) compared with white youth (14.1%).<sup>1</sup> Regarding sex disparities, African American adolescent girls (29.2%) were significantly more likely to be obese compared with their white counterparts (14.5%).<sup>25</sup> Disparities in the burden of obesity related to age were also found in a representative sample of children and adolescents from NHANES (2011-2014), which adolescents had higher odds of being obese than young children (2-5 years old).<sup>20</sup> Although overweight children from all backgrounds are more likely to become obese as adults compared to thinner children<sup>26,27</sup>, this is most pronounced in underserved groups like African Americans.<sup>28,29</sup>

Among U.S. adults, obesity prevalence has been increasing in the past decades, from 12.8% in 1960-1961<sup>30</sup> to 37.7% in 2013-2014<sup>31</sup> and 38.9% in 2015-2016<sup>32</sup>, according to the cross-sectional nationally representative health examination surveys. Although obesity prevalence seemed to have leveled off in the past decade (from 1999 to 2010) in the adult population, sub-group analysis have shown a statistically significant

increase in obesity rates in African American and Hispanic women.<sup>33</sup> Differences were also apparent by socioeconomic level, with lower age-adjusted obesity prevalence in the highest income groups than those living below the national poverty level, and also lower among those who graduated from college than those who had a high school diploma or less.<sup>34</sup>

In Baltimore, 15.3% of youth were classified as overweight and 18.6% as obese. According to the Youth Risk Behavior Surveillance (2017), obesity rates in Baltimore are above the U.S. average (14.8%).<sup>35</sup> A cross-sectional study conducted in inner-city Baltimore with middle-school aged children found a prevalence of 14.8% for overweight and 19.1% for obesity.<sup>36</sup> Among adults, the prevalence of obesity was 35.9% in Baltimore in 2014<sup>37</sup>, which was higher than rates in Maryland (28.2%).<sup>38</sup> Baltimore city low-income individuals (<\$15,000) had higher prevalence of obesity than high-income (>\$75,000), according to the 2014 Maryland Behavioral Risk Factor Surveillance System (49.7% versus 22.9%, respectively).<sup>37</sup>

Obesity is a very expensive condition. Recent evidence suggests that the total direct cost of overweight and obesity is approximately 10% of U.S. healthcare spending<sup>39</sup>, although Wang et al. (2008) have projected an increase in obesity-related costs to 16-18% by 2030.<sup>40</sup> The economic costs of other diet-related chronic diseases, such as type 2 diabetes, have increased by 27% in the past five years, according to the American Diabetes Association.<sup>41</sup> Due to its health, economical, and social consequences, obesity became one of the most pressing public health threats.<sup>42</sup>

Dietary consumption leading to an energy imbalance is among the most proximal drivers of obesity.<sup>18</sup> Diets today, especially in low-income, urban communities of color ,

are often characterized by high-energy dense and poor-nutrient foods.<sup>2,43,44</sup> However, little is known how to best address this issue in view of the complexity and multifactorial etiology of weight gain. Recently, debates about the drivers and solutions of obesity are based on the reciprocal relation between individual and environmental factors.<sup>45</sup> Furthermore, these disparities in diet quality are likely influenced by racial and ethnic residential segregations and inequalities in availability, access, and affordability of nutrient-dense foods and resources.<sup>46</sup> Therefore, further research targeting the multi factors of obesity is needed in order to inform public health actions to tackle obesity.

The subsequent sections of this chapter discuss the factors that influence dietary behaviors and are likely to affect obesity.

## ***2.2 Youth Physiological Development and Nutritional Needs***

The adolescence stage is the period of transition from childhood to adulthood, between 10 to 19 years of age. It is during this time that individuals shape their own lifestyle, preferences and behaviors for the adulthood. Moreover, development, maturation, and growth characterize this life stage by reflecting the need for a good nourishment to ensure an optimal nutritional status. It is worth mentioning that youth are those who are going to be the workers and leaders of the society in the near future.<sup>47</sup> Thus, it is of great importance to provide support for a healthy and safe environment to this vulnerable population, to impact poverty reduction, population growth, address inequalities, and promote development.<sup>48</sup> For these reasons, adolescence is perceived as a window of opportunity to address and prevent health, social, sexual, and developmental problems with a great impact on the public health field.<sup>49</sup>



The adolescent period is an important developmental stage and is characterized by puberty, in which sexual maturation, growth and psychosocial changes occur. Nutrition is an essential regulator of growth and hormones, which will be discussed in this section.

Linear growth and weight velocity are highly increased in both girls and boys during this period.<sup>50</sup> Therefore, nutrition and energy requirements are also increased due to the gain of lean mass in order to support pubertal growth and maturation.<sup>50</sup> Boys usually need more energy than girls, according to the Dietary Guidelines for Americans. Girls generally require up to 2400 calories at 18 years to sustain a healthy body weight and adolescent boys up to 3200 calories per day.<sup>51</sup> Among the minerals, calcium, zinc, and iron are among the most essential micronutrients for growth and sexual maturity of the adolescent.<sup>52</sup> Calcium is especially important for optimal acquisition of skeletal mass (needs: males and females 1,300 mg/d<sup>53</sup>), iron body storage needs are increased during adolescence and necessary to maintain hemoglobin concentration (need: male 9-13 y: 8mg/d; male 14-18: 11mg/d; female 9-13: 8 mg/d; female 14-18: 15 mg/d<sup>53</sup>), and zinc needs (male 9-13 y: 8mg/d; male 14-18: 11mg/d; female 9-13: 8 mg/d; female 14-18: 9 mg/d<sup>53</sup>) are increased during high rates of protein synthesis and increases IGF-1 secretion.<sup>54</sup>

The age range for puberty is from 7 to 15 years old and is characterized by sexual maturation. Tanner provides a scale that classifies teenagers into four stages of sexual maturation for both girls and boys.<sup>55</sup> This scale is an important tool for health professionals because it helps determine the maturity of the adolescent and therefore identify the peak height velocity – which corresponds with Tanner stages 3 and 4 in girls and boys, respectively.<sup>55</sup> Identifying the peak height velocity can be of great importance

for intervention to affect catch up growth if energy and micronutrients requirements are met.

The secretion of the growth hormone (GH) and the gonadotropin-releasing hormone (GnRH) characterize the anabolic effect of puberty. GH regulates circulating insulin-like growth factor-1 (IGF-1), which has been shown to be critical for modeling bone and necessary for the proper achievement of peak bone mass.<sup>56</sup> A higher percentage of body fat leads to earlier pubertal development through early induction of GH, therefore increasing IGF-1 resulting in taller stature, although increasing risk for obesity.<sup>50</sup> A possible explanation for this fact is that children with a high percentage of body fat and high BMI values also have high levels of leptin – a hormone that triggers Luteinizing hormone (LH) secretion, which promotes gonadal maturation and results in ovulation in girls.<sup>47</sup> Race has also been associated with early onset of puberty – African American youth reach menarche earlier than white and Hispanic girls, independently of age and BMI z-score<sup>57,58</sup>, similarly, African American boys achieve early sexual maturation than their Hispanic and white counterparts.<sup>59</sup>

In addition to hormonal and physical changes, adolescents undergo psychosocial growth that involves cognitive, moral, identity and social development. It is during this life stage that an individual will deal with a variety of changes, from pubertal changes and sexual maturation to uncertainty of physical appearance and concern with attractiveness.<sup>47</sup> Such changes combined with eating behavior and other environmental factors can influence the manifestation of nutritional disorders (obesity and undernutrition) in youth.

## ***2.3 The Multifaceted Factors of Diet-Related Behaviors***

### **2.3.1 Individual Dietary Behaviors among Children and Adults**

The diet of youth today, especially in low-income, underserved urban populations, is high in refined carbohydrates, added sugar, fats, and salt.<sup>2</sup> Sugar-sweetened beverages (SSBs), which include soda, energy drinks, fruit drinks, sweetened milk, and sports drinks, are the largest source of added sugar, and are an important risk factor for diet-related chronic diseases, such as overweight and obesity<sup>60</sup>, Type 2 diabetes mellitus<sup>61</sup>, and poor dental health.<sup>62</sup>

A recent meta-analysis of cohort studies with children reported a significantly increased risk in being overweight or obese associated with consumption of one or more daily servings of SSB.<sup>60</sup> Although SSB consumption has declined slightly over the past decade, intake remains high, especially in youth, representing 10-15% of total caloric intake.<sup>63</sup> Importantly, African American and Hispanic youth had greater increases in calories from sugar per capita than their white counterparts over the past three decades.<sup>40</sup> In addition, a recent nationally-representative study reported no decline (at 14% of total energy intake) in total energy intake from added sugar in U.S. children in the past decade.<sup>64</sup> A related issue is that children with higher intake of sugary beverages tend to snack more often than those with lower sugary consumptions.<sup>65</sup> Furthermore, snacking patterns have changed in the past decade, as low-income children increased purchase and consumption of foods high in sugar<sup>66</sup>, and increased consumption of foods away from home.<sup>67</sup> Snacks may significantly contribute to daily caloric intake, surpassing 27% of total daily calories among U.S. children aged 2-18.<sup>65</sup>

Conversely, low intake of low-calorie, healthy promoting, fiber-rich fruits and vegetables (FV) may place youth at higher risk for obesity and chronic disease.<sup>44</sup> Dietary fiber from whole grains, fruits, and vegetables is often associated with a higher diet quality and variety<sup>68</sup> and is recommended in dietary guidelines for its health promotion characteristics.<sup>69</sup> Most youth in the U.S. do not achieve the recommended amount of fruit and vegetables intake. According to the Youth Risk Behavior Surveillance, in the U.S. only a third of the youth (10-24 years old) interviewed had consumed two or more servings of fruit per day, and only 15% had eaten three or more servings of vegetables per day within the past week, with FV intake even lower among low-income youth.<sup>70</sup> Low-income urban African American youth (9-15 years old) in Baltimore City living in food deserts had a lower intake of fruit and vegetable servings when compared to the national levels, with only 26.8% and 23.8% consuming at least 2 and 2.5 servings a day, and an average intake of 1.5 and 1.8 daily servings, respectively.<sup>71</sup>

These trends are similar among U.S. adults. Analyses using nationally representative surveys have demonstrated increased intake of high energy dense foods, such as SSB<sup>72</sup> and snacks<sup>73</sup> in the past 30 decades. Trends in dietary quality from 1999 to 2010 have shown an improvement in overall diet quality mainly due to reductions in trans-fat intake; however, diet quality remains poor among U.S. adults.<sup>74</sup> Despite some recent findings showing a temporal improvement in diet quality among U.S. adults in the past years<sup>75</sup>, disparities still exist among minority populations in which improvements were not seen for African Americans and Hispanic U.S. adults.<sup>76</sup> Furthermore, the gap between dietary quality comparing high and low-income individuals have also widened in the past 12 years, from 3.9 and to 7.8 points of the Healthy Eating Index (HEI).<sup>74</sup>

Given the low consumption of healthier foods among the U.S. population<sup>77</sup>, especially among low-income African American children and adults<sup>78,79</sup>, it is necessary to test and evaluate innovative strategies to promote healthier dietary intake.

### **2.3.2 Household Factors**

It is known that parents play a critical role in influencing youths' eating behavior by controlling their food environment and acting as role models for eating behaviors.<sup>80</sup> In a previous study, eating meals prepared at home and involving youth in the cooking process were identified as household determinants of fruit and vegetable consumption.<sup>81</sup> Recently, one study documented that American families do not spend as much time cooking and preparing meals as in the 1960s, due to an increase in eating food in restaurants and obtaining food from carryout restaurants and other prepared food sources.<sup>82</sup> Furthermore, foods eaten away from home comprised 29% of the total caloric intake among low-income U.S. families.<sup>82</sup> Given the high availability of high energy-dense foods and the low availability of fruit and vegetable in carryout restaurants and fast-food sources, youth are exposed to low quality meals that increase the risk of diet-related chronic diseases.<sup>83,84</sup>

Grosso et al. (2013) found that occupational level (skilled jobs) and high education levels of parents and caregivers were significantly associated with Italian adolescents' fruit and vegetable intake.<sup>85</sup> Their results suggest that parental socioeconomic status may influence adolescent's eating behavior, which agrees with other studies conducted nationally and internationally.<sup>86,87</sup> A cross-sectional analysis using the 2013-2016 NHANES found a significant positive linear relationship between

obesity among youth (mean age, 11 years) and lower education level of household head.<sup>88</sup>

Another systematic review also identified parental intake and healthful food in the household as the most consistent determinant of FV intake among adolescents.<sup>89</sup> A cross-sectional survey assessing the association between home food environment and FV intake of adolescents in three American cities (San Diego, Boston, and Cincinnati) found that higher family income was associated with more healthy foods available in the household.<sup>90</sup> Likewise, availability of these foods at home was associated with higher FV intake among youth living in these same cities.<sup>90</sup> A recent review of the literature reported that youth living in households receiving food assistance (i.e., SNAP) obtained adequate calories, but had lower dietary quality compared with youth from non-SNAP households.<sup>91</sup> Household food availability was also identified as a moderator of the relationship between age and sex with FV intake in low-income adolescents and it also moderates the relationship between food preference and FV intake in low-income African Americans.<sup>92</sup> Furthermore, adolescent's self-efficacy for fruit consumption was found to mediate the negative relationship between parental barriers to purchasing healthy food items and adolescent's fruit intake.<sup>80</sup> Therefore, youth may also act as a change agent and influence the household food environment and their caregiver's food purchasing behavior.

Therefore, due to the influence of the home food environment on dietary behavior of children, it is important to involve adult caregivers in childhood obesity prevention programs. For instance, childhood obesity intervention involving both children and caregivers have shown more positive child-related outcomes than interventions targeting

only the child.<sup>93,94</sup> In addition, future studies should improve the household food environment to decrease childhood obesity.

### 2.3.3 The Food Environment

Dietary patterns are highly influenced by a person's food environment.<sup>23</sup> The food environment is composed of different contexts and constructs affecting access to food and influencing healthy eating patterns.<sup>95</sup> Glanz et al. (2005) identified the community and the consumer environment as influential in creating population-wide improvements in healthy eating.<sup>95</sup> The current U.S. food environment is described as unhealthy due to the high availability, low price, convenience and heavy promotion of energy-dense and nutrient-poor foods.<sup>96</sup> A poor food environment is commonly described as a food desert – an area with limited access to and affordability of healthy and nutritious food, lacking supermarkets.<sup>97</sup> The relation between the food environment and diet intake has been associated with increased prevalence of obesity,<sup>98</sup> and may explain some of the racial and social disparities in healthy eating outcomes.<sup>95</sup>

Current findings suggest that the wide availability of high-energy dense food of low nutrition value at low **cost** and the increase in the food **portion sizes** are environmental factors with negative effects on the nutritional status of individuals.<sup>99,100</sup> Another similar risk factor is related to the **inaccessibility** to healthful foods (e.g., fruit and vegetables) due to the long distance to grocery stores or supermarkets.<sup>101</sup> However, most of the literature on this topic is based on cross-sectional studies showing mixed results – the increase in supercenters was found to be associated with increased average of BMI.<sup>102</sup> Two longitudinal studies have found a positive association between proximity to fast food restaurants and BMI and fast-food consumption<sup>103</sup>, whereas no associations

were found testing proximity to grocery stores.<sup>104,105</sup> Also, studies have shown that living in low-income areas where access to healthy food is limited increases the risk of poor dietary intake and obesity.<sup>106,107</sup> Nevertheless, a recent systematic review of the literature found a small but positive effect size for the association between spatial food retail exposure (i.e., availability and accessibility) and healthier dietary intake among adults.<sup>108</sup> However, higher availability (e.g., counts, presence) of food outlets in the neighborhood appeared to produce greater positive effect sizes for relationships with dietary behaviors compared to accessibility measures (e.g., spatial proximity).<sup>108</sup> These findings highlight the need to also consider individual food purchasing preferences<sup>109,110</sup>, in-store food availability<sup>111</sup>, and consumer's perception of food access and availability when considering the food environment and its relationship with dietary behaviors.<sup>112,113</sup>

A recent cross-sectional analysis using the Nielsen National Consumer Panel data from 2000 to 2012 found that foods/beverages bought from warehouse clubs (e.g., Costco, Sam's Club), mass merchandise (e.g., Walmart, Super-target), and convenience stores (e.g., Seven-Eleven, CVS) were higher in energy, total sugar, sodium, and saturated fat compared with grocery stores.<sup>114</sup> Conversely, a longitudinal analysis using the Nielsen data from 2007 to 2012 found no statistical significant differences in the nutrient profile of foods/beverages purchased primarily in grocery stores, mass merchandisers, or a combination of both, and findings were consistent across racial-ethnic groups.<sup>115</sup> However, authors also found that African American households purchased lower nutrient quality foods and beverages than Hispanic or white households.<sup>115</sup>



Furthermore, grain-based desserts (e.g., sweet crackers, sweet rolls, cookies, cakes, breakfast bars), salty snacks, fruit drinks/juices and regular soft-drinks from all types of stores were listed as the top common sources of calories to household purchases.<sup>114</sup> In Baltimore, African American youth reported visiting small food stores on average twice a day and buying soda 1.4 times per week.<sup>116</sup> In Philadelphia, 42% of low-income school-aged children shopped at corner stores twice a day, purchasing 350 calories each visit from beverages, candy and chips.<sup>117</sup>

To date, most studies have explored geographical accessibility to food retailers (distance and density) and the availability of food within food outlets and obesity<sup>118,119</sup>, but most have been cross-sectional, focused on adult outcomes and few have explored associations with diet among adolescents.<sup>120</sup> Future studies should explore other determinants of food purchasing in addition to where people shop and what is available in-store, especially among households with fewer resources.

#### **2.3.4 Food and Nutrition Policies in the United States**

In the past decade, various national and local policies have been implemented in the U.S. that sought to change the community and consumer food environments. In 2009, the Special Supplemental Nutrition Program for Women, Infants, and Children (**WIC**) **food packages** were revised to reflect better the dietary recommendations for Americans, and to include for example, cash-value vouchers for fruits and vegetables, new whole-grain products, lower fat content of dairy foods, and reduced juice quantities.<sup>121</sup> Evaluation studies have found that the provision of healthy foods improved significantly in WIC-authorized convenience and grocery stores in Connecticut<sup>122</sup>, stores located in low-income neighborhoods in Philadelphia<sup>123</sup>, and in Baltimore City food stores.<sup>124</sup>

Furthermore, a qualitative study conducted in seven U.S. states with WIC-authorized storeowners found that owners perceived increased numbers of customers, sales, and profits in their stores after the policy changed.<sup>125</sup>

Following the 2009 WIC changes, the city of Minneapolis revised an ordinance in 2014 requiring all food stores (grocery, corner stores, gas stations, dollar stores and pharmacies) to stock healthier foods aligned with the WIC requirements with the goal to improve availability and access to staple foods, particularly in low-income neighborhoods.<sup>126</sup> This was the first **Staple Foods Ordinance** in the U.S., but compliance has been a challenge – only 63% of the 240 stores are in full compliance with the ordinance. Despite the technical assistance provided by the Health Department to store owners, additional support is needed, including marketing and business planning to store owners to help to improve demand of healthier foods.<sup>127</sup>

Another example of a local policy to change the food environment was the creation of the **Pennsylvania Fresh Food Financing Initiative** to attract supermarkets and grocery stores to underserved areas.<sup>128</sup> There were 88 new or expanded fresh food retail outlets developed in low-income areas since 2004. Despite the moderately improved food access perception of dwellers, there has not been an effect on fruit and vegetable intake nor on BMI among consumers.<sup>113</sup> Inspired by the Pennsylvania Initiative, the USDA launched the **Healthy Food Financing Initiative** to increase presence of healthy food retailers in underserved communities, classified as food deserts, throughout the U.S.<sup>129</sup> Findings have challenged the initiative demonstrating that little to no change in store healthy food availability and consumer's diet.<sup>130</sup> Therefore, physical access to grocery stores or supermarkets may not fully explain inequalities in healthy

food access – price, availability, convenience, and promotion are other examples of factors that should be taken into consideration when improving the food environment. Moreover, a recent health economic modeling study suggested that exposing low-income households to the same food availability and prices would only decrease nutritional inequality by less than 10%, while the remaining may be explained by differences in demand, such as nutrition literacy, marketing, and health education.<sup>131</sup>

In summary, national and local policies to improve the community food environment have been implemented with high feasibility, and successfully improved the availability of healthier food in small food stores. However, there is little evidence on the impact of these policies on the consumer food acquisition and consumption, particularly among youth in low-income urban settings. Policies that implement price manipulations, including taxation (e.g., SSB or junk food) or subsidization of healthier foods (e.g., Double Buck Program) seem to positively impact consumer's food choices.<sup>132</sup>

## ***2.4 Social and Behavioral Theories***

Having described the multiple factors and strategies at the different socioecological levels that influence food-related behaviors, it is also important to recognize that theories help understand the possible reasons and pathways an intervention/program may or may not affect the targeted behavior. Most health behavior research use social cognition models in recognition that psychological determinants mediate mental process that can enact individual's behavior, or even change the environment.<sup>133</sup> Common examples of these theories are the health belief model<sup>134</sup>, the theory of planned behavior<sup>135</sup>, the transtheoretical model<sup>136</sup>, and the social cognitive theory.<sup>12</sup> Recent reviews of the literature and meta-analysis identified that theory-based

interventions were marginally more effective and more reliable than intervention not based on theories.<sup>137,138</sup> This dissertation evaluated a public health nutrition intervention that was underpinned by the social cognitive theory and the socioecological model. Thus, this section discusses the aforementioned models.

### **2.4.1 Social Cognitive Theory**

Another important context influencing healthy eating patterns is the psychosocial context. According to the **social cognitive theory** (SCT)<sup>12</sup>, psychosocial factors might influence eating behavior, as it has been theorized that the cognitive processes play an important role in the acquisition and retention of new behavior patterns.<sup>12</sup> Bandura's theory recognizes that a dynamic interplay exists between **people, environment, and behavior**. SCT evolved from the social learning theory, in which **self-efficacy** was added as one of the key intrapersonal constructs: reciprocal determinism, behavioral capability, observational learning, reinforcements, and expectations. Moreover, youth-level psychosocial factors such as self-efficacy and intentions for healthy eating was associated with greater odds for fruit, vegetable, and fiber intake among 10-14 year old African American youth living in Baltimore food deserts.<sup>71</sup> Self-efficacy, the extent of confidence and decision-making about healthy eating, is the most commonly measured psychosocial construct and has been identified as an important predictor of fruit and vegetable intake.<sup>139-141</sup> Nonetheless, other studies have not found consistent association between these psychosocial factors and healthy eating patterns.<sup>142,143</sup>

Another strength of this theory is that it provides a framework that allows the design, implementation, and evaluation of programs and interventions in many different fields. However, a limitation of this theory is that it does not specify what the

environmental factors are (community, food sources, culture, media, or policy).

Moreover, the theory gives little attention to social support, conflicts and emotions that may be associated with self-efficacy, for example. Some also may criticize that social learning process does not come from solely observational learning. In summary, this theory focuses on the interpersonal level factors of behavior change, and it is often used in research and program along with other theories such as the socio ecological model, that in addition, address the macro-levels influencing behavior and other outcomes.

### **2.4.2 Socio Ecological Model**

The **socio ecological model** (SEM) focuses on environmental and political contexts, while incorporating psychosocial influences in order to design effective multi-level strategies to improve health behavior.<sup>144</sup> In addition, the SEM assumes that only providing motivation and skills may not be as effective in changing individual behaviors if the environmental and political contexts make it difficult - or even impossible - for an individual to make healthier choices. Therefore, multiple context levels influence human behavior, suggesting the need for intervention programs taking a multilevel approach.<sup>14</sup>

Multi-sectoral strategies and **multilevel nutrition intervention programs** with youth have grown in the past decade to better understand food behaviors and to decrease childhood obesity levels. In the past years, obesity prevention has gained a more holistic understanding due to its complex nature, with multilevel frameworks rooted in social ecological model being recommended for further research and interventions to better generate public health solutions.<sup>145</sup> Multilevel interventions are suggested to be more effective than single component interventions, due to their synergetic effect between educational strategies and environmental factors.<sup>146</sup>

## **2.5 *Childhood Obesity Prevention Interventions***

Interventions to combat childhood obesity have been recommended by leading organizations such as the World Health Organization<sup>147,148</sup> and the Institute of Medicine.<sup>149</sup> Although the evidence of what works to improve healthy eating to ultimately tackle childhood obesity is growing, childhood obesity prevention trials have shown mixed results and small effect sizes in changes in child BMI.<sup>146</sup> Thus, this section discusses the intervention strategies most used in the previous decade to combat the issue of childhood obesity, with a special emphasis on interventions conducted primarily in schools (setting that received most attention in the childhood obesity literature)<sup>9</sup> and in community settings (considerable growing interest in the body of the literature).<sup>5</sup> Due to the multifactorial causes of obesity, solutions at the different levels of the socio ecological model (i.e., multilevel) paired with actions at the various components of the food environment (i.e., multicomponent) provide a promising population-based approach to improving children's health, and are also reviewed in this section.

### **2.5.1 *School-based Childhood Obesity Interventions***

Most child obesity prevention interventions have been primarily school-based, conducted in developed countries, targeting elementary or middle-aged youth.<sup>9,146</sup> Systematic reviews and meta-analysis have reported a mild effect of school-based interventions in reducing BMI among children, with increased beneficial effects with parental involvement.<sup>150-153</sup> School-based childhood obesity interventions have also demonstrated positive effect on children's dietary behavior. A one-year school-based obesity prevention program in the United Kingdom observed a decrease in consumption of carbonated beverages among youth 7-11 years old compared to those not receiving the

nutrition education program.<sup>154</sup> Another randomized control trial conducted with preschool African American children in Chicago found a better diet quality - measured by the Healthy Eating Index (HEI) - and an increase in fruit intake among the intervention group receiving the nutrition and physical activity curriculum delivered by teachers.<sup>155</sup>

Despite some positive effects on health outcomes and dietary outcomes, few obesity prevention trials assessed maintenance of impacts. Among those assessing sustainability of findings there is a lack of further impact on obesity-related behavior after the study is over.<sup>9</sup> The lack of a long-term effect of the intervention, or even a null effect of intervention on children's health have been attributed to compensation effects of the household or community environments.<sup>156</sup> The possible mechanism is that children may change behaviors while in school, but may alter their behaviors outside of school, thus attenuating the effect of the intervention.

For these reasons, community-based intervention trials have gained considerable interest in the obesity prevention literature and became a promising approach to combat childhood obesity with sustainable and long-term impacts reaching large sectors of the population.

### **2.5.2 Community-based Obesity Interventions**

Community-wide approaches to childhood obesity prevention are aligned with the social ecological model, in which different levels are equally targeted to change the food environment in and around the individual.<sup>8</sup> Examples of community-based intervention to change the food environment include the *Baltimore Healthy Store* (BHS)<sup>157</sup>, *Philadelphia Healthy Corner Store* (PHCS)<sup>158</sup>, and the *Minneapolis Healthy Corner Store* (MHCS)<sup>159</sup>

trials aiming to increase access to healthy food in the community and to support healthy food choices through point-of-purchase promotion among adults. In the BHS study, there was a positive impact on healthfulness of food preparation methods, and respondents in the intervention areas were significantly more likely to report purchasing promoted foods because of the presence of a BHS shelf label.<sup>160</sup> Whereas in the PHC, there were no significant changes from baseline to follow-up in energy content or nutrient characteristics per purchase after one year of the intervention.<sup>158</sup> The MHCS reported an increase in availability and sale of fresh produce among the stores participating in the program.<sup>159</sup>

A recent systematic review on community-based childhood obesity interventions reported that most interventions have targeted the community plus another setting (an educational setting or home), with significant but modest reductions on child weight-related outcomes.<sup>5</sup> The systematic review did not find any study that was implemented only at a community setting that sought to prevent childhood obesity. This may be due to the emerging evidence that interventions implemented at multiple sectors are more effective than single-sector interventions.<sup>9,161,162</sup>

### **2.5.3 Multilevel Multicomponent Obesity Prevention Interventions**

Multilevel community interventions to prevent childhood obesity have combined different components of the food environment with simultaneous actions at the different levels across the SEM, including the home, school, social media, community food stores, and policy-levels. Multilevel multicomponent (also often termed as “multi-setting, multi-strategy”, or whole-of-community) interventions have reported positive small effects on childhood obesity.<sup>163,164</sup>



Shape Up Somerville (SUS) is one example of community-based obesity prevention program that successfully increased availability of healthy foods in schools by improving schools' food service, but also worked outside of the school environment.<sup>165</sup> SUS implemented new menu items, capacity building of school personnel, conducted taste testing and other communication strategies in the school setting, accompanied by interventions in the homes and community setting in the urban area of Boston. SUS researchers found a statistically significant decrease in Body Mass Index (BMI) z-scores in children<sup>166</sup>, reduction in sugar sweetened beverage intake after 2 years of intervention, but no impact on daily fruit and vegetable servings.<sup>167</sup> One of the methodological limitations of the SUS study is that individuals were not randomly assigned to intervention or control group. Another limitation is that parents reported their children's eating behavior, which may have been biased and not a reliable measure of children's intake.

A 2-year community-based nonrandomized intervention in New Zealand in children 5-12 years old – APPLE (A Pilot Programme for Lifestyle and Exercise) – presented significant changes in BMI z-score among intervention group when compared to the control group. The intervention targeted the individual, household, and school-levels, and although had a primary focus on improving physical activity levels, the second year of the intervention incorporated nutrition-based activities with children.<sup>168</sup> These activities included science lessons in schools, community-based healthy eating resource, and the provision of free fruit for 6 months. Community activity coordinators facilitate physical activities during lunchtime, after-school, and vacations (e.g., outdoor games, gardening, community walks) and provided cooled water filters to each

intervention school. At baseline and follow-up, children answered a 3-day short food questionnaire to report frequency of consumption of 33 food items. Children in the intervention group had increased daily serving of fruit (mean difference = 0.8) and vegetable (mean difference = 0.3) from pre- to post-evaluation when compared to those who did not receive the intervention.<sup>169</sup>

Another successful childhood obesity prevention trial was the Switch program, implemented in multiple ecological levels in two U.S. states – Minnesota and Iowa – aimed at improving physical activity level, decreasing screen time, and improving fruit and vegetable consumption in children 9-11 years old attending 10 schools.<sup>170,171</sup> The program intervened in three different levels: community (involved city stakeholders and social media for a public education intervention to prevent childhood obesity, and provided children and families with opportunities to engage in community activities such as scavenger hunt at local grocery store and swimming), school (nutrition curricula, and communication materials), and family (mailed information, activities, recipes, meal plan, and tips to achieve nutrition and physical activity goals).<sup>170</sup> At the beginning and at the end of the school year, children reported frequency of food consumption from the previous day, and differences were seen between intervention and comparison groups in terms of the program impact on daily fruit and vegetable consumption, with significantly increase in the intervention group.<sup>171</sup>

Other recent multilevel childhood obesity prevention programs have also generated mixed results. For instance, four randomized, controlled trials that were part of the *Childhood Obesity Prevention and Treatment (COPTR) Consortium* tested interventions to prevent obesity in preschoolers and treat obesity in children 7-13 years

old in primary care, parks and recreational centers, household, and schools.<sup>172</sup> None of the COPTR studies found a significant improvement on child BMI.<sup>173-176</sup> Importantly, these studies did not intervene in the community food or PA environments.

Although the abovementioned trials (i.e., SUS, APPLE, and Switch) intervened in multiple levels of the food environment, APPLE and Switch were primarily school-based. Thus, this highlights the need for multi-level interventions to test strategies in other settings rather than schools.<sup>9</sup> In addition, most studies have focused on the food environment targeting elementary- and middle-school aged youth, which raises the need for further research to also target older children and adolescents.<sup>9</sup> Moreover, previous longitudinal studies have reported important differences in food patterns across youth ages, with older youth (>12 years old) snacking and purchasing foods out of the home more frequently than younger youth.<sup>177</sup> Therefore, it is important to investigate impact of nutrition interventions on different ages due to different food behaviors and societal eating norms, increased caloric intake, and changes in body composition.

Furthermore, many health disciplines have incorporated youth into intervention teams as mentors to interact directly with younger children.<sup>178</sup> However, relatively few youth-led programs have focused on obesity prevention and supported healthy eating practices and reported impact of the trial on diet and food-related behaviors.<sup>179</sup> Social modeling or observational learning principles provide part of the rationale for involving peers in behavior change interventions, as peers have the potential to serve as role models of the targeted behavior.<sup>178,180</sup> The results of youth-led interventions tend to be equivalent, or superior to adult-led interventions<sup>181,182</sup>, resulting in more positive attitudes toward behavior change.<sup>183</sup> Impact on children obesity rates in low-income African

American youth was seen in a youth-led multi-level obesity intervention trial (Baltimore Healthy Eating Zones).<sup>184,185</sup>

#### **2.5.4 Evaluation of Multilevel Multicomponent Interventions**

Quantitative evaluations are complex in community-based multilevel multicomponent obesity prevention studies with numerous logistical, practical and methodological challenges that emerge from its multifaceted and resource-intensive design.<sup>186</sup> Multiple intervention strategies occurring simultaneously in different community settings, make it difficult to attribute the effect of the intervention to specific intervention strategies or to the intervention as a whole due to the presence of community-level confounding variables.<sup>187</sup> Furthermore, community-based intervention trials often assume that the intervention protocol was implemented according to the initial standard, but programs are often adapted to the reality and the needs of the community or may not reach its intended target population, which may explain away treatment effects on the outcome of interest.<sup>10</sup>

Given the importance of implementation to study outcomes, various community-based multilevel multicomponent interventions have used process evaluation to assess intervention fidelity (adherence to intervention protocol).<sup>168,188,189</sup> Process evaluation usually provide context to outcome measures. However, exposure (‘dose received’) is rarely measured, but allows researchers to understand how well a program reached its intended audience from the participants’ perception of their personal exposure and the extent to which they actively engaged with the research activities and materials.<sup>190</sup> The IDEFICS study, a large cross-cultural intervention across 7 countries in Europe for childhood obesity prevention – implemented an exposure questionnaire to assess

family/parents engagement and exposure to the school and community components.<sup>191</sup> Exposure scores were created for each component and correlated with changes to BMI z-score among children, with an overall no relationship with positive changes in children's BMI, but country-specific analysis showed positive changes among German girls.<sup>191</sup> The Boost program, a Danish multi-component school-based trial, used measures of exposure as the extent of parental involvement in the intervention, and found that students with a high exposure level consumed more fruits and vegetables daily than those with low exposure score.<sup>192</sup> The *Switch what you Do, View, and Chew program* that targeted children 9-11 years old attending 10 schools in Minnesota and Iowa, U.S., observed greater change in FV weekly intake among caregivers who were more involved in the intervention, compared to those who were less involved.<sup>171</sup>

In randomized controlled trials, analysis including engagement/adherence to the intervention in outcome evaluations are also known as treatment-on-the-treated effect (TTE) or per-protocol analysis, in which study participants are analyzed according to the treatment received, instead of the original treatment assigned (average treatment effects). Although this practice may violate randomization, increase potential biases, and results may not infer causal-effect of the intervention, it is often used as secondary evaluation analysis<sup>193</sup> and may provide an upper-bound on program effectiveness.<sup>194</sup>

Additionally, insufficient evaluation of the impact of multilevel community-based childhood obesity prevention trials on diet and food behaviors in child and their caregivers exists.<sup>9</sup> Furthermore, childhood obesity prevention programs that also engaged adult caregivers have shown more positive child-related outcomes than child-only interventions.<sup>93,94</sup> However, few child-focused interventions have reported impacts on

caregiver behavioral outcomes<sup>195</sup>, due to limited assessment of nutrition behaviors among this group.<sup>196</sup> Understanding the impact of childhood obesity prevention on caregivers is important because families' eating practices, rules, and support influence children to initiate and sustain positive dietary changes, while providing opportunities for social learning.<sup>197</sup>

In light of the current gaps in childhood obesity prevention literature, this proposed research will add to the body of literature in three important ways:

- 1) Utilize a food-targeted randomized multilevel community-based obesity prevention trial in a low-income urban food desert setting that sought to modify the out of school environment;
- 2) Evaluate changes in diet by control and treatment group among youth and their caregivers;
- 3) Explore changes in dietary and food-related behaviors by level of exposure to intervention components to provide further information on reasons for and directions of the observed effect.<sup>187</sup>

## **2.6 Preliminary Studies**

Having described some multilevel obesity prevention trials conducted in other settings, this section will focus on previous work done in Baltimore City to inform the multilevel multicomponent childhood obesity prevention trial evaluated in this dissertation. The *B'more Healthy Communities for Kids* intervention was funded as part of the Global Obesity Prevention Center at Johns Hopkins, supported by the *Eunice Kennedy Shriver* National Institute of Child Health and Human Development (NICHD) and the Office of the Director, National Institutes of Health (OD). The program was

implemented by a multidisciplinary team and led by the Primary Investigator Dr. Joel Gittelsohn, who has implemented successful obesity prevention trials to improve the low-income food environment in the past two decades. **Table 2.1** describes the previous studies conducted in Baltimore. All community-based interventions were developed through formative research and a community engagement process in which community members and other key stakeholders contributed ideas and strategies to plan and implement the program.<sup>198-200</sup> Efforts have centered on increasing access to healthier foods (availability, pricing), and promoting these foods through point-of-purchase materials (shelf labels, posters), interactive sessions (taste testing of healthier foods, flyers) and promotional giveaways.

**Table 2.1:** Previous obesity prevention trials conducted in Baltimore City to inform the B'more Healthy Communities for Kids intervention

<b>Study</b>	<b>Description</b>	<b>Intervention Levels</b>	<b>Results</b>
<i>Baltimore Healthy Stores (BHS)</i>	Retail food store-based intervention trial comparing East and West Baltimore.	1. Supermarkets 2. Corner Stores 3. Consumer	Improved adult food preparation methods and frequency of purchase of promoted foods <sup>157</sup> ; and a positive trend for healthy food intentions. <sup>160</sup>
<i>Baltimore Healthy Eating Zones (BHEZ)</i>	Clustered randomized childhood obesity prevention trial.	1. Corner Stores 2. Carryouts 3. Recreation Centers 4. Peer Educators 5. Youth (10-14 years old) 6. Caregiver	Decrease in BMI percentile among overweight and obese children, improved food-related outcome expectancies and food knowledge. <sup>185</sup>
<i>Baltimore Healthy Carryouts (BHC)</i>	Environmental intervention in Baltimore carryout	1. Carryouts 2. Consumer	Increased sales and consumption of healthy food items

	restaurants using a quasi-experimental design.		promoted among adult consumers. <sup>201</sup>
<i>B' More Healthy Retail Rewards (BHRR)</i>	Multi-level randomized controlled communication and pricing intervention to improve food environment in Baltimore City.	1. Wholesaler 2. Corner Stores 3. Consumer	Increased stocking of promoted foods. Increased sales of healthy snack foods in the combined (communication and pricing) intervention group. <sup>202</sup>

***Baltimore Healthy Stores (BHS)***. From 2005-2007, two trials (Baltimore Healthy Stores 1 & 2) were conducted in 21 retail food stores, including supermarkets and small food stores. Small storeowners received gift cards to local wholesalers to incentivize their stocking of healthier foods. Shelf labels, posters, flyers, giveaways, and taste tests/education sessions were used to promote healthy foods to low-income African American adults. The study was implemented with high reach, dose, and fidelity regarding stocking of promoted foods, displaying materials in the store level, and implementation of in-store taste tests.<sup>203</sup> Intervention stores were more likely to increase and sustain the promoted food availability at intervention, post-intervention, and follow-up.<sup>157</sup> BHS had a positive impact on healthfulness of food preparation methods and food purchasing among adult consumers.<sup>160</sup>

***Baltimore Healthy Eating Zones (BHEZ)***. The BHS study was expanded to BHEZ to target low-income African American youth. The program<sup>184</sup> was implemented in 7 recreation centers and 21 nearby corner stores. The 8-month intervention aimed to increase availability and selection of healthful foods through nutrition promotion and nutrition education using point-of purchase materials, such as posters and flyers in stores



around recreation centers, and via interactive sessions.<sup>184</sup> The intervention program was associated with reductions in youth BMI percentile among children who were overweight or obese at baseline ( $p = 0.04$ ). Intervention youth significantly improved food-related outcome expectancies ( $p = 0.02$ ) and knowledge ( $p < 0.001$ ).<sup>185</sup>

***Baltimore Healthy Carryouts (BHC)*** was a pilot intervention with a quasi-experimental design in 8 carryout restaurants in low-income areas of Baltimore City targeting adult consumers. The study included environmental strategies such as developing and replacing menu boards to promote existing healthy menu options with photos and using a green leaf theme to signalize the healthier options. In addition, BHC used promotional posters, introduction of healthier beverages and side dishes, and promotion of lower cost condiments, and substitution of low-fat cooking ingredients.<sup>204</sup> Acceptability, fidelity, and perceived sustainability of the new menu board and poster interventions were high among carryout restaurant owners.<sup>205</sup> The BHC intervention was associated with increased sales of healthy foods and total revenues<sup>206</sup>, consumers significantly increased their purchase of healthier food items.<sup>201</sup>

***B' More Healthy Retail Rewards (BHRR)*** was the first randomized controlled trial to involve food wholesalers in a food access intervention program on healthy food purchasing and consumption among low-income small store adult customers.<sup>202</sup> Twenty-four small corner stores located in low-income census tracts of Baltimore City were randomized to one of four treatment groups: communications only ( $n = 6$ ), pricing only ( $n = 6$ ), combined communications and pricing ( $n = 6$ ), or control ( $n = 6$ ). Performance allowances in the form of healthy food discounts (10-30% off wholesale price) were directed from the wholesaler to the pricing only and combined intervention stores (12

stores total) at checkout for 6 months during 2012-2013. All intervention stores significantly increased stocking of healthy promoted foods compared to control. Moreover, store receiving both communication and pricing intervention showed significantly increase in sales of healthy promoted snacks.<sup>207</sup>

The studies described above established the potential for success of community-based, multilevel interventions; however, none of them combined all levels into one study. Furthermore, there are still some important gaps in the food environment literature to improve supply and demand of healthy food in underserved populations that could be tested in Baltimore City. For example, little attention has been given to the area of sustainability, as previous trials have focused only on program effectiveness.<sup>208</sup> Involving city stakeholders and policymakers as part of the research team, increases the potential to improve and sustain food policies and initiatives to support citywide strategies to improve availability, access, and purchasing of healthy food in low-income food desert areas.<sup>209</sup> Another innovative strategy to intervene in the food environment is the use of social media tools, which none of the abovementioned studies have previously tested. Social media and mobile tools are potentially far-reaching and cost-effective components and may be a powerful tool to promote health.<sup>210</sup> Lastly, although the use of youth-led participatory programs has increased in the past years, relatively few youth-led programs have focused on obesity prevention and healthy eating practices.<sup>181,211</sup>

Thus, the B'more Healthy Communities for Kids study sought to fill the current gaps by utilizing all different levels tested in the previous studies, and including social media and policy components to a youth-led obesity prevention intervention.

## 2.7 Chapter Summary

The diet of youth today, especially in low-income, underserved urban populations in the United States, is high in refined carbohydrates, added sugar, fats, and salt.

Interventions to address childhood obesity by improving healthier food intake and decreasing unhealthful food behaviors are needed, particularly in low-income settings, as poor-quality diet is an important risk factor for overweight and obesity. Behavior change is complex and requires multilevel solutions; however, few studies have tested multilevel environmental nutrition interventions targeting adolescents in non-school settings.

Reviews of the literature on multilevel multicomponent childhood obesity interventions have indicated promising impact on food-related behaviors among youth, and few have evaluated whether it also influences household-level behaviors. Drawing from lessons learned and strategies tested in previous environmental interventions in Baltimore City, *B'more Healthy Communities for Kids* sought to combine multiple approaches to prevent childhood obesity among low-income urban African American youth (9-15 years old) in Baltimore City. The intervention also tested innovative innovations to change the multiple levels of the food system by 1) incorporating peer mentors in the delivery of a culturally appropriate intervention; 2) testing the use of social media as a means to target adult caregivers for behavior change; 3) involving policymakers and city stakeholders to support and improve food policies to improve the city's food environment.

## **Chapter 3.       Methods**

This chapter provides an in-depth review of the methods employed to conduct this dissertation. It first provides an overview of the *B'more Healthy Community for Kids* parent study, describes the context of the study setting and population, and implementation of the multiple components of the intervention. The methods include quantitative data collection and analysis, and ethical considerations.

### ***3.1 Overview of the B'more Healthy Communities for Kids***

The B'more Healthy Communities for Kids (BHCK) intervention was a multilevel multicomponent (MLMC) childhood obesity prevention trial in Baltimore City. By definition, as a MLMC intervention, BHCK integrated different levels of the socio-ecological model and multiple intervention components into a food systems approach that promoted access to nutritious food from wholesalers, to small food stores, and to families (both adult caregivers and youth). Children were targeted by intervening in community recreation centers, having youth-leaders (college and high-school trained mentors) leading education and nutrition skills sessions, and through social media. In addition, food demos and promotions in the community carried out by BHCK interventionist were timed to reach children leaving the school (from 2-4pm). Following the socio-ecological model, the BHCK intervention tapped into the dynamic interplay among individual, behavior, household, environment, and policy levels.<sup>14</sup>

This dissertation study utilized the group-randomized MLMC BHCK study to assess changes in diet and food-related behaviors of low-income families living in areas with poor availability of healthy foods receiving the program, compared to those not

receiving the program. Previous research in this topic have used quasi-experimental designs, have not been conducted for a long period (more than 12 weeks), or was mainly conducted in the school settings.<sup>9,212</sup> Furthermore, most studies exploring the relation between the food environment and child health, have focused primarily on weight change (e.g., BMI) – a more distal factor that is influenced by both physical activity and diet.<sup>21</sup> Therefore, this study improves to prior literature by identifying intervention strategies to improve youth's and caregiver's diet (increased fruit and vegetable servings intake, decrease added sugar and fat intake) and food-related behaviors (improved healthier food shopping and food preparation behaviors) through a group randomized multilevel community-based obesity prevention trial.

### ***3.2 Study Setting***

The B'more Healthy Communities for Kids research study took place in low-income urban areas of Baltimore City, Maryland, U.S. Baltimore City is located in the Northeast region of the country on the Chesapeake Bay, with the second-largest seaport in the Mid-Atlantic. According to the 2016 U.S. Census Bureau, Baltimore City has a total population of 621,000, a median household annual income of US\$ 44,262.00, and 11.8% unemployment rate.<sup>213</sup>

In Baltimore City, 25% of the residents live in an area with low access to healthier and affordable foods, of those, 34% are African Americans and only 9% are white. A previous study in Baltimore City reported that predominantly African American and lower income neighborhoods had significantly lower healthy food availability and more corner stores, than predominantly white and higher-income neighborhoods, which may

help explain some of the racial and social disparities in healthy eating and obesity outcomes.<sup>214</sup>

Baltimore is an ideal location to test a multilevel multicomponent program, as the city is made up of many neighborhoods with inadequate access to healthy and nutritious foods. Many of these lower income areas are classified as food deserts where small corner stores and carryout restaurants are the primary source of food for the community.<sup>97</sup> According to the Johns Hopkins Center for a Livable Future (CLF) latest report in 2015, Baltimore City had about 47-chain supermarket stores, with only 14 supermarkets located in predominantly African American neighborhoods. It was also found an uneven distribution of corner stores in the city, which were primarily located in predominantly African American neighborhoods.<sup>215</sup> Corner stores are ubiquitous in Baltimore, with more than 600 located in the city. A corner store is generally characterized by being located on the corner, operated by the owner, and typically do not carry healthy food items, such as fresh produce. Corner stores are commonly used by children and their families<sup>116,216</sup>, and are often the only nearby retail food source available to many families in Baltimore.<sup>217</sup>

The food environment, combined with other economic and social factors such as low vehicle ownership and high crime rates, can make access to healthier foods even more difficult. A recent longitudinal study found that an increased neighborhood crime rate was associated with an increase in density of unhealthy food outlets in the previous 13 years in Baltimore City.<sup>218</sup> Additionally, individuals who do not own a personal vehicle tend to rely more frequently on the food outlets that are available in their immediate neighborhood, than those who own a vehicle. A cross-sectional study with 175

African American adults living in East and West Baltimore City neighborhoods reported that walking was the most frequent form of transportation used for food purchasing, and individuals who mainly walked as a means of transportation were likelier to obtain unhealthier foods than those who had access to a car.<sup>217</sup>

The school food environment is another important component of the Baltimore food system that influence youth's dietary intake, as children spend most of their time outside of the home in school and recreation facilities, interacting with their peers.<sup>219</sup> In the U.S., the national school lunch program (NSLP) was established in 1946 and subsidized free or reduced-price meals based on children's income eligibility. Only recently, under the 2010 Healthy, Hunger-Free Kids Act, the NSLP was revised and school meal standards have become more closely aligned with dietary recommendations. Under the Hunger Free Schools Act of 2015, Baltimore City Public Schools implemented free breakfast and lunch programs that are now offered to all youth regardless of their income.<sup>220</sup>

After-school programs also offer free meals and opportunities for physical activity. The Department of Baltimore City Recreation and Parks operates 41 recreation centers that offer after-school programming for over 23,000 children between 5-18 years old. These recreation centers serve as the primary after-school program for Baltimore City children. Many community recreation centers are associated with specific elementary or middle schools, and offer free snacks and free supper meals programs. The vast majority of children who attend these centers are African American, from low-income households, attend schools with free lunch, and purchase foods from small stores and carryout restaurants surrounding the recreation centers before and after school.<sup>116,221</sup>

Therefore, recreation centers were identified as promising intervention sites and chosen as the nucleus of the neighborhoods for the BHCK study. Recreation centers not located in low-income predominantly African American areas of the city were excluded from the randomization (n=11). From the 30 neighborhoods eligible to participate in the BHCK study, 26 were randomized to intervention and comparison over two waves of implementation. **Table 3.1** illustrates the sociodemographic characteristics of the BHCK zones. BHCK was implemented across all regions of Baltimore City, although more predominantly in the East and West areas. Compared to the average statistics of Baltimore City, BHCK zones had a higher proportion of African Americans (average of 80% African Americans versus 62.4% for the entire city), higher prevalence of individuals living below the poverty rate (35% versus 10.4%), lower frequency of vehicle ownership (35% versus 18.3% without vehicles), and lower median annual household income (\$30,659.00 versus \$44,262.00).

**Table 3.1:** Sociodemographic characteristics of the neighborhood zones participating in the B'more Healthy Communities for Kids study

Recreation Center	Neighborhood	Region	% AA <sup>1</sup>	Median Household Income (US\$) <sup>2</sup>	# Corner Stores <sup>2</sup>	# Supermarkets <sup>2</sup>	% No Vehicle <sup>2</sup>	% < Poverty Line <sup>1</sup>	Crime Rate <sup>3</sup>	BHCK Wave
BHCK Intervention										
Coldstream	Homestead	E	83	38,859	48	3	32.7	29.0	69.9	1
Greenmount	Barclay	E	80	33,920	65	4	40.8	42.7	66.5	1
John Eager Howard	Reservoir Hill	N	78	41,125	79	4	47.8	34.9	59.6	1
Madison Sq.	Orangeville	E	37	22,450	80	2	61.2	30.0	81.0	1



Recreation Center	Neighborhood	Region	% AA <sup>1</sup>	Median Household Income (US\$) <sup>2</sup>	# Corner Stores <sup>2</sup>	# Supermarkets <sup>2</sup>	% No Vehicle <sup>2</sup>	% < Poverty Line <sup>1</sup>	Crime Rate <sup>3</sup>	BHCK Wave
Collington Sq.	Collington	E	86	23,284	89	3	51.5	51.2	55.0	1
Fort W.	Berea	E	92	28,663	83	4	32.6	32.2	55.0	1
Chick Webb	Latrobe Homes	E	87	12,574	89	5	76.6	68.5	82.6	1
Cecil Kirk	Midway	E	92	24,446	67	3	50.3	36.7	66.5	2
Carmelo Anthony	Washington Hill	E	71	18,842	64	3	66.3	41.9	82.6	2
J.D. Gross	Edgecombe	W	95	27,041	25	2	47.3	30.0	51.5	2
Towanda	Greenspring	W	92	27,708	24	2	29.2	44.3	51.5	2
DeWees	Cameron Village	NE	81	42,589	12	1	21.7	12.0	39.9	2
Rita Church	Clifton Park	E	95	33,636	29	2	26.4	24.3	69.9	2
Carroll F. Cook	Orangeville	SE	37	29,844	5	0	22.1	30.0	81.0	2
BHCK Comparison										
Furley	Frankford	E	80	32,309	14	2	27.3	17.7	56.6	1
Samuel F. B. Morse	Milhill	W	52	18,146	79	2	69.1	45.9	80.7	1
C. C. Jackson	Central Park Heights	N	98	28,824	36	2	42.2	34.8	51.6	1
Edgewood	Edmonson Village	W	95	40,000	40	2	27.2	23.0	103	1,2
Lilian Jones	Sandtown/Winchester	W	98	19,189	103	2	76.1	47.3	59.6	1,2
Bentalou	Penrose	W	95	27,668	98	2	46.9	38.7	63.1	1,2
Patapsco	Cherry Hill	S	96	13,743	9	1	66.8	65.3	53.5	1,2
Cahill	Mt. Holly	W	94	52,315	16	1	20.0	21.8	50.0	2
Easterwood	Easterwood Park	W	99	34,254	103	2	40.7	23.5	63.1	2
Solo Gibbs	South Baltimore	S	35	53,603	17	1	17.9	35.0	49.8	2
Mary Rodman	Allendale	W	93	35,899	34	1	42.2	27.0	38.9	2

Recreation Center	Neighborhood	Region	% AA <sup>1</sup>	Median Household Income (US\$) <sup>2</sup>	# Corner Stores <sup>2</sup>	# Supermarkets <sup>2</sup>	% No Vehicle <sup>2</sup>	% < Poverty Line <sup>1</sup>	Crime Rate <sup>3</sup>	BHCK Wave
Brooklyn O'Malley Pal Center	Southwest Baltimore	S	37	36,203	13	1	26.4	22.0	80.7	2
Baltimore City										
Baltimore City Average			62.4	44,262	61.6	47	10.4	18.3	60.5	n/a

Abbreviations: AA: African American; BHCK: B'more Healthy Communities for Kids; E: East; N: North; NE: northeast; SE: southeast; S: South; W: West; n/a: not applicable

<sup>1</sup> U.S. Census Bureau (2016). <https://censusreporter.org/profiles/14000US24510260201-census-tract-260201-baltimore-md/>

<sup>2</sup> Maryland Food System Map (2014): <https://trude.maps.arcgis.com/home/webmap/viewer.html?useExisting=1&layers=5bb2bd52794048d091ba14aa1cedb907>

<sup>3</sup> Vital Signs Baltimore Neighborhoods (2016). [https://bniajfi.org/vital\\_signs/fullreport/](https://bniajfi.org/vital_signs/fullreport/)

### 3.3 Study Design

The BHCK intervention was a group-randomized controlled trial implemented at multiple levels of the urban food environment to improve healthy food access, purchase, and consumption among low-income families living in food deserts in Baltimore. The BHCK study used pre- and post- intervention assessment design, with two groups – intervention and comparison. The intervention was implemented in two waves (wave 1: August 2014-February 2015; and wave 2: November 2015-August 2016), with pre- and post-assessments for each wave.

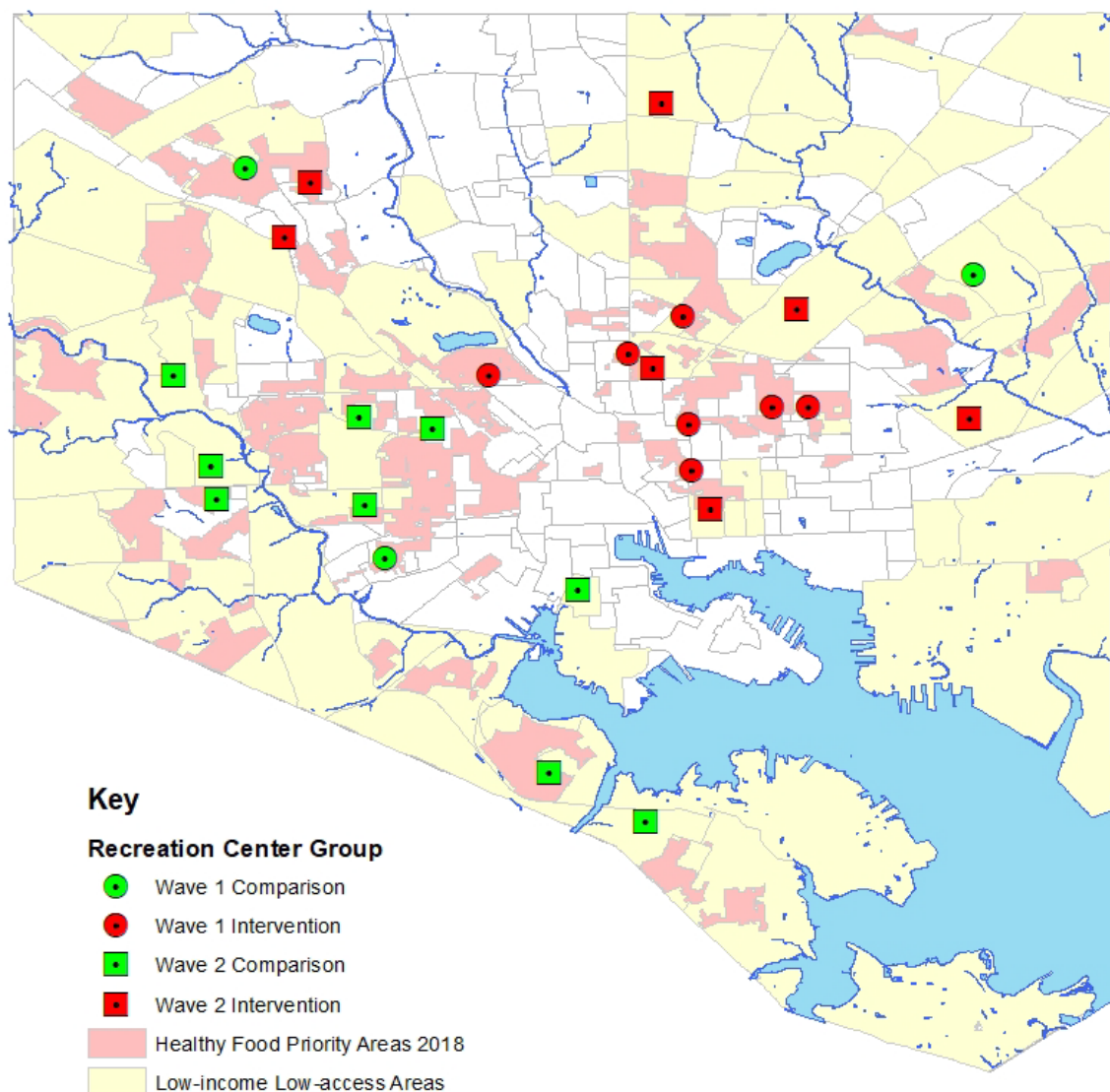
#### 3.3.1 Randomization of neighborhood zones (recreation centers)

Wave 1 took place in 14 zones, randomized to intervention (n = 7) and comparison groups (n= 7), and wave 2 in 16 zones, randomized to intervention (n=7) and

comparison (n=9), using simple randomization (1:1 ratio). Assignment occurred publicly by drawing names of eligible recreation centers from a hat. A recreation center was at the nucleus of each zone, and zone's eligibility criteria were:

- 1) predominantly African American (>50%);
- 2) low-income neighborhood (>20% of residents living below the poverty line);
- 3) minimum of 5 small (<3 aisles, no seating) food sources;
- 4) recreation center more than ½ mile away from a supermarket and located in a food desert.<sup>214</sup>

In this study, predominantly African American neighborhoods were considered having more than 50% of residents Black or African American. If a neighborhood had more than 20% of its population living below the poverty line (majority household annual income < \$35,000), it was considered low-income. Baltimore City's food desert was defined as an area with limited access to and affordability of healthy and nutritious food, ½ mile away from supermarkets, >30% of residents with no vehicle access, and low healthy food availability index (HFAI).<sup>111,215</sup> From the 41 operating recreation centers, 30 were considered eligible and then randomized (**Figure 3.1**). Four recreation neighborhoods (Bentalou, Edgewood, Lilian Jones, and Patapsco) that were randomized to comparison group in wave 1, were re-randomized in wave 2 to comparison group. Therefore, twenty-six different BHCK neighborhoods were selected to participate in the study.

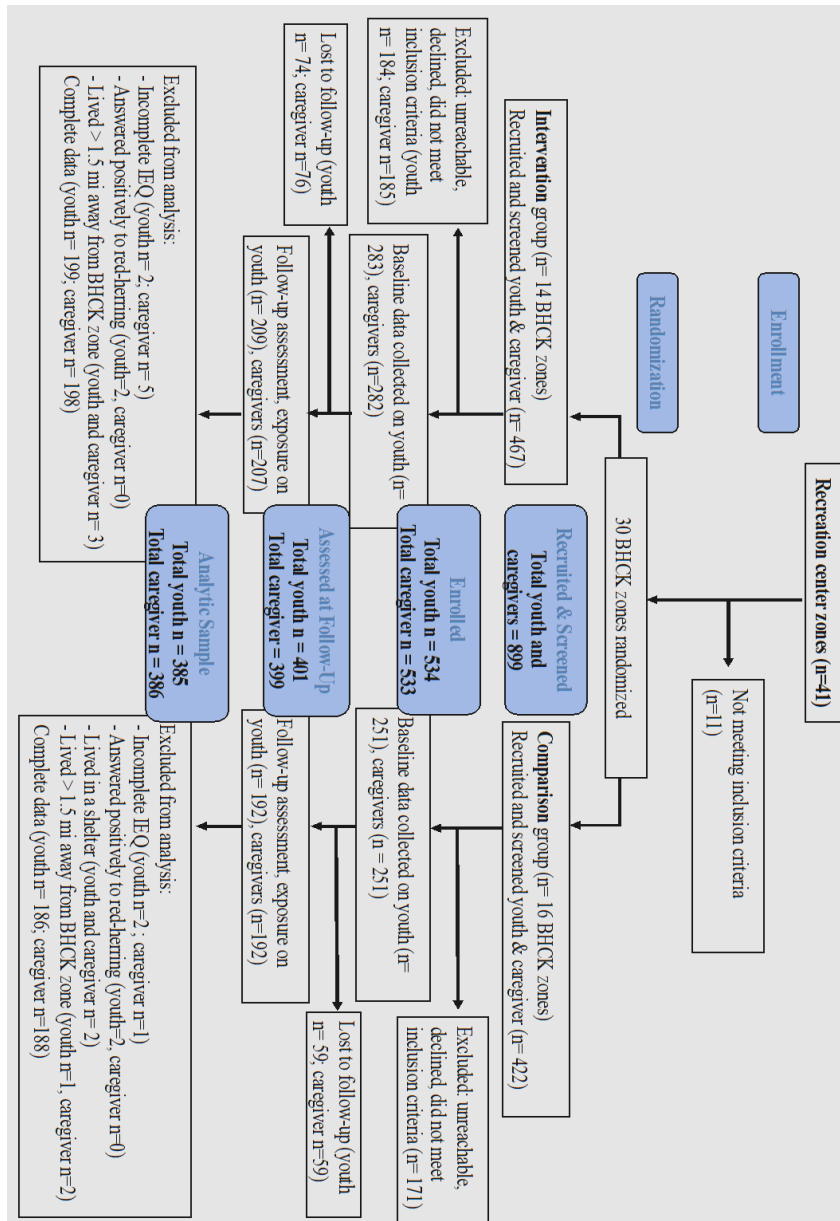


**Figure 3.1:** B'more Healthy Communities for Kids low-income intervention areas (recreation center zones)

### ***3.4 Recruitment***

A sample of adult caregiver and child dyads were recruited at each recreation center and nearby corner stores and community locations, using a 1.5-mile BHCK buffer zone around each rec center. In each buffer zone, interested individuals provided their phone numbers directly to study staff, and BHCK research assistants contacted and

screened potential participants. Household eligibility criteria included: (1) at least one child in aged 9-15 years; (2) living in the same location for at least one month; and (3) not anticipating a move in the next 2 years.<sup>11</sup> An overview of study enrollment and participant flow is provided (**Figure 3.2**).



**Figure 3.2:** CONSORT flowchart of the B'more Healthy Communities for Kids intervention

Originally, a sampling frame was developed to aid in the random selection of caregiver-child dyads in each BHCK zone. BHCK data collectors approached children (9-15 years old) and their caregivers in participating recreation centers, nearby corner stores and carryout restaurants, and parks and community venues in the 1.5-mile BHCK buffer. Children and adults were approached about the study and invited to provide their names and phone numbers for contact. A list of 75-100 names of individuals approached in each zone and their contact information was entered into the frame, with the goal to randomly select 20 dyads from each neighborhood, per sample size calculation (see **section 3.9**). If a randomly selected dyad was unable or deemed ineligible to participate, then the next dyad was contacted and invited to participate in the randomized sampling frame. However, it was difficult to follow-up with most of the recruited participants due to disconnected phone and scheduling conflicts, which resulted in most zones having all the names contacted in the sampling frame in order to reach the final sample size. The sampling frame creation protocol was also responsible for the lengthy baseline data collection period in wave 1 (13 months). For logistical reasons and because the list ended up being exhausted at the end of baseline data collection, BHCK did not employ the sampling frame protocol for dyad data collection in wave 2. In the second round of the study, individuals were approached in the communities in the same manner as wave 1, but immediately called, screened, and invited to participate in the study. Once the 20 dyads were interviewed, recruitment ceased in the recreation center zone. Thus, within randomized zones, the BHCK dyad selection can be considered a convenience sample due to the non-probability sampling at the individual-level.

Zone assignment to intervention or comparison were concealed from the BHCK research assistants who conducted the post-intervention assessments. Child's main caregiver was screened for eligibility of the household prior to obtaining parental consent and being interviewed for the study. We conducted baseline and follow-up interviews on a sample of 18 dyads for each of the 30 zones. Individuals living in the four BHCK recreation centers that were re-randomized in wave 2 had their wave 1 follow-up interview also considered as wave 2 baseline, but with a different identification number. The total sample at baseline was 534 dyads (534 children between 9-15 years old and 533 adult caregivers).

### ***3.5 BHCK Multilevel Multicomponent Intervention Strategies and Implementation***

The BHCK intervention was divided into three phases, each lasting two months: 1) healthy beverages, 2) healthful snacks, and 3) healthful cooking methods. A fourth phase, intended to review main messages covered in the previous phases, was implemented in wave 2 only ("review phase"). During the healthful beverages phase, the program promoted healthier alternatives to SSBs as part of each component (social media, small food stores, recreation center, youth-leader, wholesaler, policy) across all levels (individual, household, environmental, and policy), including lower-sugar fruit drinks (25-75% less sugar than the original version), sugar-free drink mixes, zero-calorie flavored water, diet or low-sugar soda, and water. During the healthful snacks phase, BHCK promoted low-fat and low-sugar alternatives to unhealthier snacks, including low-fat yogurt, low-fat popcorn, fresh fruits, fresh vegetables, low-sugar granola bars, and mixed fruit in 100% fruit juice. In the healthful cooking phase, the intervention promoted

cooking ingredients, such as low-sugar cereals, low-fat milk, 100% whole wheat bread, fresh/canned/frozen vegetables across all BHCK components.

Promoted beverages and snacks qualified as *healthier* in the BHCK intervention were selected based on formative research and focus group discussions held with youth within the targeted age group.<sup>222</sup> These healthier alternatives were selected to be comparable in both flavor profile and price point to unhealthy snack foods youth would normally purchase and consume. *Healthier* snacks and beverages in the BHCK study contained no more than 10% of the daily-recommended value for fat, 10g of sugar, and/or were good sources of fiber. These included low-fat string cheese, low-fat yogurt, low-sugar granola bars, fresh fruit, fruit cups in 100% juice, applesauce, sliced apples, popcorn, pretzels, baked chips, water, and low-sugar beverages. *Unhealthier* foods were snacks and beverages low in fiber and high in sugar, starch, and fat (products containing >10% of the daily value from sugar or fat), including baked goods, chocolate and non-chocolate candy, crackers, snack chips, soda, fruit punch, and sweetened tea.

BHCK encompassed four different socioecological levels – policy, environmental, interpersonal and intrapersonal – as well as multiple components involving wholesalers, small food stores (corner stores and carry-out restaurants), recreation centers/peer-mentors, and social media. The BHCK components are described below.

### **3.5.1 Policy**

This level worked with key city stakeholders to develop policies for a healthier food environment in Baltimore City, and to sustain BHCK activities. This component run in parallel with other BHCK intervention components and was not intended to directly



reach children and their adult caregivers. BHCK held policy meetings every 3-4 months with policymakers to identify the champion for the cause aiming at sustainability of the program. In addition, BHCK provided evidence-based information to support policies at the city level using Geographic Information System (GIS)/System Science simulation models to simulate policies impact in order to aid stakeholder decision-making (e.g., urban farm tax credit, mobile meals).<sup>223</sup> During the BHCK intervention, BHCK organized ten meetings (2-hour duration, every four months) with multiple stakeholders (e.g., city councilmen, food policy director, wholesaler manager, Recreation and Parks Department staff, Health Department staff). This component was implemented with high reach, and medium dose delivered and fidelity, according to detailed process evaluation measures set a priori.<sup>224</sup>





### **3.5.2 Wholesaler**

BHCK partnered with three wholesalers in Baltimore City, and each was encouraged to stock BHCK-promoted food items. Wholesalers were given stocking sheets with information of food products promoted during the BHCK program and asked to stock items that were not being currently stocked in the wholesale store. Foods and beverages were promoted through signage, in which a shelf-label was placed by a BHCK-interventionist in the wholesale stores highlighting the promoted item to storeowners.<sup>225</sup> Wholesalers also provided a \$50 gift card to small stores participating in the program at the beginning of each phase to encourage initial stocking of a new promoted item (subsidized by BHCK). BHCK-interventionists visited each wholesaler at least once per month to maintain shelf-labels position, and monitor availability of

promoted items.<sup>225</sup> This intervention component was implemented with high reach, dose delivered, and fidelity, according to quality standards set a priori.<sup>225</sup>

### **3.5.3 Corner stores and carryout restaurants**

We recruited 3-4 corner stores and/or carryout restaurants in each BHCK zone (corner store [intervention n=29, comparison n =23], carryout restaurants [intervention n=13, comparison n=15]). We worked with storeowners in intervention zones to improve supply and demand for healthier options of food and beverages.<sup>225</sup> Specifically, in carryout restaurants, storeowners worked with research team to develop a new menu board to encourage lower-fat cooking methods in carryout food preparation.<sup>226</sup> Small retailers were provided with gift cards from wholesalers, a stocking sheet with the promoted items, and were encouraged to stock at least one new promoted item every other week. Moreover, storeowners watched six training videos that provided information about the program, how to best improve customer relations, and use of healthier cooking methods (carryout owners only).<sup>227</sup> After completing each training module, owners were offered store supplies as a reward, ranging from produce baskets to refrigerators, as part of the BHCK tiered incentive program (**Figure 3.3**). To increase demand for healthier alternatives, BHCK used materials and incentives (point-of-purchasing promotion and giveaways), and in-store taste tests, for example, fruit flavored water, baby carrots, and low-sugar granola bars, during two-hour educational sessions (delivered every other week in each intervention store by BHCK-interventionists). Posters and handouts promoting the food items were placed in all intervention stores. According to detailed process evaluation measures, this component was implemented with medium reach and dose delivered, and medium-high fidelity based on study protocols.<sup>225,226</sup>

Tier I	Tier II	Tier III	Tier IV
Completed all BHCK intro videos	Completed 3 additional training videos	50% of shelf talkers in the right location and at least 1 new products brought in from phase/s (1 or 2 )	50% of shelf talkers in the right location and at least 1 new products brought in from phase/s (2 or 3)
<b>Cutting Board</b> <b>Jr. Portion Control scale</b> <b>One-Line Labeler</b> <b>Labels</b> <b>Produce Basket</b> 	Sturdy 1,2,3 dump bins 2 speed drink blender Chalkboard Sidewalk sign 	Bistro Set Paint for exterior of store 	Small Refrigerator Small Freezer Basket Tray Display 

**Figure 3.3:** BHCK tiered incentive program for corner store and carryout owners.

#### 3.5.4 Peer-mentor/ Recreation center

Youth leaders (29 Baltimore City college and high school students) were trained by BHCK-interventionists in leadership and nutrition to conduct educational sessions in 14-intervention recreation centers with children through a peer-intervention approach.<sup>228</sup> Youth leaders were involved in the delivery of the intervention based on the perspectives of social cognitive theory, as a way to enable mentees to model mentors' health behavior.<sup>229</sup> Fourteen sessions implemented every other week (total of 6 months) by youth leaders followed the themes of each BHCK phase. Nutrition sessions lasted one hour, during which youth leaders implemented the BHCK nutrition curriculum with hands-on activities related to the different sugar and fat content in each drink and snack, and introduced a traffic light labeling method for beverages and snacks.<sup>230</sup> Giveaways and taste-tests were also conducted at the end of each session that was aligned with the lesson. Two BHCK-interventionists oversaw execution of sessions to monitor quality of implementation of the intervention (medium reach, dose delivered, and high fidelity). All

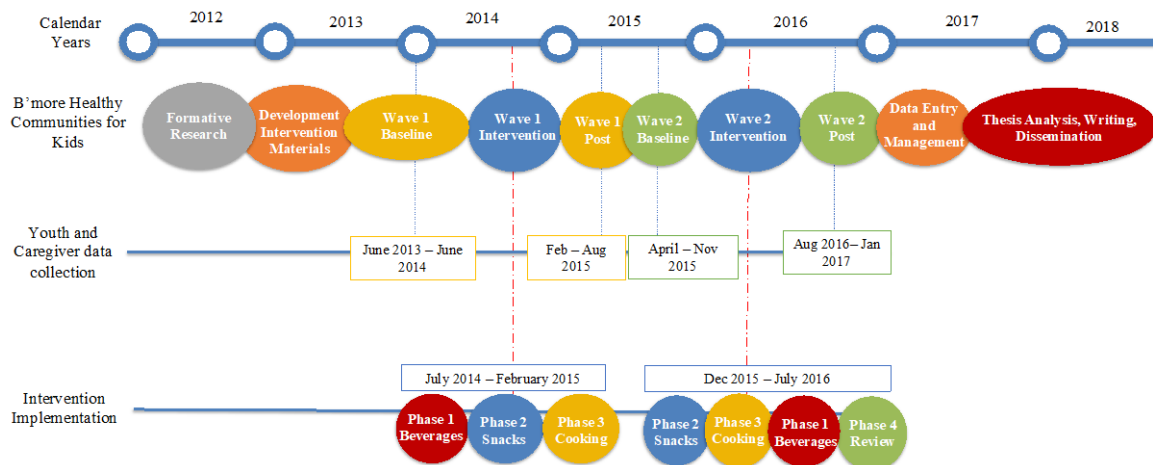
children in the 9-15-year range attending the after-school program at the time of the intervention could participate in the nutrition education sessions. Although recruitment also occurred in recreation centers, study participant youth were not required to attend intervention sessions. This component was implemented with medium reach and dose-delivered, and high fidelity, according to a priori standards for process evaluation.<sup>230</sup>

### **3.5.5 Caregiver-directed media**

Caregivers were targeted mainly through social media, a texting program (wave 1 and wave 2), and a mailing program (wave 2 only). Social media (Facebook and Instagram) were used to integrate all the levels of BHCK to inform family-level nutrition behaviors. Recipes, news, and BHCK-specific activities were featured in these communication channels. Social media pages were public accounts with daily posts that mirrored the content of text messaging and other BHCK components. Study participants were encouraged to share online achievement, barriers, tips, and resources on these social platforms. Text messages (sent 3 times/week) and social media platforms also targeted mainly youth's caregivers by guiding them to set and achieve goals to healthier behaviors for themselves and their families, as well as promoting BHCK community activities. The social media and text messaging component employed goal-setting, bi-directional communication strategies. An example of a goal setting text message was as follows: *"Does your child have a sweet tooth? Try offering them granola bars or fruit as an alternative to candy 1 time this week."* This component was implemented with high reach, dose delivered, and fidelity.<sup>231</sup> Program flyers and promotion of the intervention were mailed to caregivers and youth twice a month at the end of wave 2 only, as part of phases 3 and 4.

### 3.6 Timeline

The timeline for this thesis and the BHCK parent study is illustrated in **Figure 3.3**. BHCK was a five-year intervention trial, with the first year devoted to formative research and development of the intervention materials. The first round of baseline data collection occurred between June 2013 and July 2014, followed by the implementation of the first BHCK wave (July 2014-February 2015). Post-intervention evaluation of wave 1 dyads occurred between February and August 2015, overlapping with wave 2 baseline data collection (April to November 2015). Subsequently, wave 2 was implemented for eight months (November 2015-August 2016), and post-data collection concluded in January 2017. The order of the intervention phases was slightly modified in wave 2 to promote beverages (i.e., water, low-sugary beverages) in the warmer months, as it was done in wave 1.



**Figure 3.4:** Overview of the timing of the B'more Healthy Communities for Kids implementation, data collection, and thesis work

### ***3.7 Training of Interventionists and Data Collectors***

BHCK-interventionists were graduate students, public health educators, dietitians, or youth leaders trained in nutrition and health education, and were not masked to the treatment group (zone) assignment. Data collectors were graduate students and staff who were intensively trained, including through role plays and observations, and received feedback and certification from the lead investigator (Joel Gittelsohn, PhD), the research coordinator (Cara Shipley, RD), and doctoral students (Angela Trude, MS; Betsy Anderson Steeves, RD, PhD, and Anna Kharmats, MA). They were masked after assignment to intervention to reduce information bias. Following the interviews, data were checked for errors by the interviewer and a second research analyst. The data manager ensured that questionnaires had no missing pages or implausible values. After data checking, all forms were entered into a Microsoft Access database and the data manager conducted a reentry of a 10% random sample. Errors were identified and corrected. Once all participant responses were validated and entered into the database, the data was converted to a Stata dataset for analysis. The Block Kids FFQ was also checked for errors and incompleteness, copied, and sent to NutritionQuest for analysis. Database was sent via email as excel file and also via mail in a CD-ROM, then converted to a Stata dataset for analysis.

### ***3.8 Data Collection***

Baseline data collection was conducted on all dyad samples. All interviews were conducted in person at a location that was convenient for the participants such as a recreation center, a community location, the participant's home, or at the Johns Hopkins

Bloomberg School of Public Health. Adult caregivers were interviewed for about 90 minutes at pre- and post-intervention and received \$20 gift card for each completed interview. The child participants were interviewed for about 105 minutes (1-hour 45 minutes) at pre-intervention and post-intervention and received \$30 gift card upon completion of the interview. The instruments used to assess the participants are listed in **Table 3.2** and described with more detail below.

**Table 3.2:** B'more Healthy Communities for Kids dyad data collection methods

<b>Domain</b>	<b>Method</b>	<b>Collection</b>	<b>Key Variables</b>	<b>Time (min.)</b>
Dietary Intake	<u>Child</u> : Block Kids Food Frequency Questionnaire  <u>Caregiver</u> : NIH FV Screener	Baseline and Follow-up	Energy intake, F&V servings, SSB intake, total fiber, fat intake, sodium, sugar intake, % kcal from sweets	30
Food Purchasing and Preparation Behavior	Child Impact Questionnaire (CIQ)  Adult Impact Questionnaire (AIQ)	Baseline and Follow-up	Frequency and variety of purchase of food items, frequency and type of healthier cooking methods	20
Exposure	IEQ- Intervention Exposure Questionnaire	Follow-up	Component subscale score, overall exposure score	15

### 3.8.1 Dietary outcomes

Diet and food-related behaviors in youth and their caregivers were assessed at pre- and post-intervention (between 6-12 months from baseline assessment).

Youth dietary intake were measured using the **Block Kids 2004 Food Frequency Questionnaire (BKFFQ) (Appendix 8.1).**<sup>232</sup> The BKFFQ instrument is a semi-quantitative, validated questionnaire in adolescent populations<sup>232,233</sup> that ascertains previous week's frequency (from 'none' to 'every day') and consumption amount of 77 common food items (with three to four categories related to food type). It contains foods identified by NHANES II commonly consumed by youth. Completed FFQs were analyzed by NutritionQuest (Berkley, California, USA) and estimates of food and nutrition intakes were generated for each youth. Daily fruit and vegetable intake were estimated in cup equivalent servings and dietary fiber was estimated in grams. Vegetable servings exclude potatoes and legumes, and fruit servings include 100% fruit juice. The food groups for the database for the BKFFQ were developed using NHANES and the USDA's My Pyramid Equivalents Database 2.0 (MPED). All foods and beverages reported in the NHANES 24-hour recalls were assigned values in the MPED database. Most foods, including mixed dishes, contribute to more than one food group.

Nine questions were included at the end of the original BKFFQ to elicit the intake of BHCK promoted foods: 1) low-sodium condiments, 2) low fat/low-sugar snacks, low-fat granola bars, low-fat string cheese, baked chips, popcorn, and trail mix; 3) diet and low-sugar drinks; 4) water intake. However, those questions were not analyzed by NutritionQuest. **The original BKFFQ instrument has been validated in many studies compared to multiple diet records, and conducted in different populations in the U.S, including in African American youth.**<sup>234,235</sup> Cullen et al. 2008 conducted a study to test reliability and validity of the youth questionnaire among 83 youth aged 10-17 years, comparing the Block Questionnaire with two-day 24-hour dietary recall.<sup>232</sup> In



general, the validity assessment of the questionnaire using Pearson's correlation coefficient resulted in moderate to high correlation for most of the foods and nutrients, including energy (0.50), percent energy from carbohydrates, fats, and protein, dairy intake, and fruit serving. Lower correlation coefficients were found for grains (0.22), fruit juices (0.26), fiber (0.30), and vegetables (0.12).<sup>232</sup> Furthermore, all reliability intraclass correlations were above 0.30, but below for fruit and vegetable servings. This difference in the two dietary methods specifically regarding fruit and vegetable intake may be due to the low daily intake of this food group among youth, in which a two-day recall would not be able to capture the intake.

**The National Cancer Institute (NCI) FV screener** was used to collect usual consumption of 10 categories of FV intake in adult caregivers over the past month (**Appendix 8.2**). It is a short dietary assessment instrument consisting of 14 questions and is a modified version of the FV screener from the Eating at America's Table Study.<sup>236</sup> The screener inquired about frequency of intake of fruit, 100% fruit juice, and vegetables (lettuce, greens, potatoes, and legumes) consumed in a monthly, weekly, or daily basis. The amount of each food item was estimated as cups or servings and self-reported by the participant. We calculated the total number of both fruit and vegetable servings consumed daily using the 2005 MyPyramid definition of cup equivalents. For each food group, we multiplied the average frequency (daily) by the cup equivalent. The instrument has been validated and presents high correlations with 24-hours recalls, and is less burdensome compared to other instruments.<sup>237</sup> Food models were used to improve accuracy of serving size information.

The NCI FV Screener was added to the data collection protocol after wave 1 intervention had begun and was first administered during wave 1 post-intervention. Therefore, the effect of the intervention on FV intake of adults was calculated only using BHCK wave 2 sample with pre- and post-evaluation data (n=196), as this instrument was not used during wave 1 baseline data collection.

### **3.8.2 Food-related behaviors**

Food purchasing behaviors (meal preparation and food acquisition) were assessed pre- and post-intervention (from 6-12 months after baseline).

The **Child Impact Questionnaire (CIQ)**<sup>71,238</sup> was used to collect food-related information in youth (9-15 years old) at pre- and post-intervention (**Appendix 8.3**). The CIQ consisted of 79 questions and was used to collect information pertaining to youth food consumption, food preparation, and food-purchasing habits, along with measures of demographic information, youth psychosocial factors related to healthy eating, including behavioral intentions, outcome expectancies, self-efficacy, and knowledge.<sup>71,238,239</sup> The questionnaire was adapted on the basis of formative research from previous intervention trials in Baltimore.<sup>240,241</sup> The questionnaire was pilot tested with youth (n=20) for clarity and relevance of the instrument items.

For the youth food purchasing behavior, youth were asked to report all the places they purchased food and the frequency of food and beverage purchased for themselves in the 7 days prior to the interview. **Table 3.3** contains the list of 38 BHCK-promoted healthier foods and beverages and 28 unhealthier foods and beverages that were included in the CIQ.

**Table 3.3:** Frequency of food purchasing items in the Child Impact Questionnaire

<b>Healthy foods items (n=38)</b>	1% or skim milk, diet soda, water, 100% fruit juice, sugar free drinks, fruit flavored water, unsweetened tea, fresh fruits such as apples, oranges, bananas, frozen and canned fruit, fresh, frozen, and canned vegetables, canned tuna in water, low sugar/high fiber cereals, 100% whole wheat bread, hot cereal, pretzels, baked chips, reduced-fat chips, dried fruit, nuts or seeds, cooking spray, grilled chicken, grilled seafood, fruit and vegetable as side dishes, deli sandwich, tacos, yogurt, granola
<b>Unhealthy foods items (n=28)</b>	whole milk, 2% milk, regular soda or regular energy drinks, fruit drinks, sweetened iced tea, sports drinks, applesauce, sugary cereals, white bread or split top wheat, burger, pizza, fried chicken, fried seafood, fries, fried chicken sandwich, carryout-Chinese food, chips, baked goods (cookies, cakes, poptarts), chocolate candy, ice cream, juice popsicles, snow cones, other candies.

For the youth food preparation behavior, youth reported the number of times they prepared food in the previous 7 days for themselves or for the household. Then, they listed the foods prepared in the past week and reported the cooking method used for each preparation, including fried, baked, microwaved, raw, and other. Food preparation was defined minimally, by at least combining two or more food items. For instance, spreading butter onto toast, pouring milk into a cereal bowl. Food preparation was also considered if new foods have been microwaved or heated in the oven, e.g., baking frozen chicken nuggets. However, food items previously prepared by someone else or from carryout restaurants were not considered prepared if only heated at home.<sup>238</sup>

Household level information were assessed through the **Adult Impact Questionnaire** (AIQ) answered by the youth's primary caregiver (**Appendix 8.4**). This was a 176-item questionnaire and includes questions on demographics and household socioeconomic information (parental education, marital status, and employment status, and household income, housing arrangement of the primary caregiver, and household

participation in food assistance programs), and included questions on food purchasing, and food preparation.<sup>7</sup>

For caregiver food acquisition behavior, caregivers reported the number of times they purchased or got food from different food sources in the previous 30 days from the interview date for themselves and/or for the household. A list of 18 different food sources (i.e., farmers market, urban farm, street vendor, public market, corner store, supermarket, carryout restaurant, sit-down restaurant, wholesaler food store, specialty store, food pantry, community center, convenience stores, an *Arabber*<sup>1</sup> or mobile produce cart, and family/friends) was provided to assess the purchasing frequency in each food source. Household food acquisition was determined based on how often the household acquired selected foods over the past 30 days (e.g., “How many times did you get these foods?”). A list of 31 healthier and 23 unhealthier foods was provided. Prepared foods acquired from delis, vendors, or restaurants were not included, as this instrument was designed to measure foods purchased for consumption in the home environment rather than for immediate consumptions. Unhealthier items were higher in fat and/or sugar. Examples of unhealthier food items included: whole milk, regular sodas, hot dog, bacon, sugary cereals, white bread, chips, cookies, ice cream, and ketchup. Healthier items were foods and drinks that were lower in fat and/or sugar, or were “light” or “diet” versions of unhealthy foods and beverages. Examples of healthier items included: water, pretzels, sugar free fruit drink, yogurt, low-sugar cereal, fruits, and vegetables.<sup>7,242</sup>

For food preparation behavior, caregivers were asked to rank the top three most common cooking methods used when they prepared chicken, turkey (including ground

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<sup>1</sup> Horse-drawn produce cart vendors – a Baltimore historical tradition.

turkey and turkey bacon), pork (including bacon), ground beef, fish, eggs, greens (excluding lettuce), and potatoes. Most common cooking methods included: baked/broiled, boiled, pan-fried in oil/fat, pan-fried and drained, deep fried, grilled, steamed, cooked with cooking spray, microwaved, drained and rinsed, and raw.<sup>242</sup> Information about the frequency of household meal preparation in the past 30 days prior to the interview date was also gathered.

Additional measures were collected on psychosocial factors for healthy eating (intentions, self-efficacy), health beliefs and attitudes, nutrition knowledge, household food security, social support for healthy and unhealthy eating, and individual and family medical history, but are not reported in this dissertation.

### **3.8.3 Exposure evaluation**

The key variables for assessing exposure were obtained from the Intervention Exposure Questionnaire (IEQ) collected as part of the post-intervention assessment for both the intervention and comparison groups (**Appendix 8.5**).

The 29-item IEQ included questions to measure exposure to each component of the intervention over the course of program delivery – Store and Carryout Component (16 questions); Recreation center (5 questions); Text-messaging (1 question); Social Media (4 questions); Program logos and branding (3 questions). For visual materials, participants were asked whether they had ever seen the materials during the intervention period (i.e., BHCK logos, posters, handouts, giveaway, educational displays, store shelf-labels, and social media posts) aided with an Exposure Packet to assist with recall (**Appendix 8.6**). For example, the question to assess exposure to BHCK posters was worded: “*The BHCK project put up posters in stores, carryouts, and recreation centers.*”

*Which of the following have you seen and/or read?*”. For each item, individuals were shown examples materials used during the intervention from the Exposure Packet, and were prompted to respond “yes”, “no”, or “maybe”. Because we developed a wide variety of handouts and posters throughout the intervention, we randomly chose a subset of examples in the IEQ to reduce respondent burden.

Only youth were asked about recreation center activities such as cooking classes held in the center and frequency of recreation center attendance during the year of the intervention. Only adults were asked about participation in the BHCK text-message and engagement with the social media programs during the year of the intervention, because these intervention components were targeted specifically at caregivers. Only when assessing exposure to the store component, we asked youth and adults to report the number of times they shopped in the BHCK intervention corner stores and carryout restaurants in the previous 7 days to the interview to improve precision of report; at the same time, we showed them pictures of the stores’ facades to aid with recall.

In addition, eight red herring questions were used to address response bias, and included materials used in previous studies conducted in different sites. For instance, on the question about exposure to BHCK posters, one out of the ten posters was from an intervention conducted with Native Americans. We classified individuals into tertiles of red herring responses, where selecting 0-2 red herring answers was considered truthful, 3-5 moderate, 6-8 untruthful responses and kept only individuals in the tertile with the least number of red herring responses. Respondents who answered positively to  $>3$  (1/3 or more) of the red herring questions, were excluded from analysis.

### **3.8.4 Covariates**

Sociodemographic characteristics of youth and their caregivers were collected at baseline and post-evaluations using the Child Impact Questionnaire (CIQ) for youth's age and sex, and the Adult Impact Questionnaire (AIQ)<sup>7</sup> for caregiver and household information. The AIQ included questions on demographics and household socioeconomics: caregiver's age, sex, education level (categorized into < high school, completed high school, and > high school), household annual income (US\$0-10,000 (23.9%); 10,001-20,000 (22.9%); 20,001-30,000 (17.2%); or 30,001-80,000 (35.9%)), housing arrangement (owned, rent, and shared with family or other arrangement (group housing, transitional housing)), number of individuals in the household, and food assistance participation (received WIC (Special Supplemental Nutrition Program for Women, Infants, and Children) or SNAP (Supplemental Nutrition Assistance Program) benefits in the past year).

Youth's and Caregiver's height and weight were measured using a Seca 213 Portable Measuring Rod stadiometer and a Tanita BF697W Duo Scale. Participants were measured with their shoes removed, wearing light clothing. The measurements were taken in duplicate, and a third measure was taken if the first two measures were more than 0.2 pounds, or 0.25 inches different. Repeated measures were averaged to secure higher reliability of the method. For participants who declined to have their height and weight measured, self-reported data was collected. For caregivers, Body Mass Index (BMI) was obtained calculating  $\text{kg/m}^2$ . In this thesis, overweight was defined for adults as BMI between 25 and 29.99  $\text{kg/m}^2$  and obesity as BMI greater than or equal to 30

kg/m<sup>2</sup>. BMI-for-age and sex specific Z-scores were calculated using youth's height and weight and compared to the age and sex-specific WHO BMI-for-age growth reference.<sup>15</sup>

### ***3.9 Sample Size and Detectable Effect Calculation***

To estimate the sample size and the detectable difference estimate, an analysis was conducted prior to implementation of BHCK accounting for 30 recreation center zones (unit of randomization), controlling for a power of 80% (1- $\beta$ ) and a probability of a type I error of  $\alpha=0.05$  (two-sided). Given that the study sample was drawn from 30 different zones, some clustering was expected. Between-zone variance ( $\sigma^2_g$ ) was calculated using within-zone variance ( $\sigma^2_m$ ) and Intraclass Correlation Coefficient (ICC):  $\sigma^2_g = (\sigma^2_m \text{ICC}) / (1 - \text{ICC})$ . The original sample size calculation for BHCK drew upon BHS baseline data on adult food purchasing to address the proposed hypothesis. Results indicated a sample size of 720 adult caretaker-child dyads (this was equivalent to 24 dyads from each zone) for the intervention assessments. Assuming a 20% drop-out after two years, this resulted in a minimum final sample of 600 adult caretaker-child dyad respondents at post-intervention. BHCK would then be able to detect a 4-6 points change in the healthy food purchasing variety score, reflecting four to six additional healthy food purchased once a week.

To account for changes in the BHCK study design (higher attrition rates than 20%), this thesis employed a “redesigned” detectable difference estimate of the change in youth's fruit and vegetable serving, deriving estimates from the BHCK wave 1 baseline sample. The following detectable difference formula provided by Murray<sup>243</sup> was used in the equation (1) below:

**Equation (1):** 
$$\Delta = \sqrt{[(2 \cdot (\sigma^2_m + m \cdot \sigma^2_g) \cdot (t\alpha/2 + t\beta)^2) / mg]}$$



From wave 1 BHCK baseline, the unadjusted residual error variance  $\sigma^2_m$  and ICC for servings of fruits and vegetables are 6.30 and 0.004, respectively. Let  $g$  represent the number of group per condition (14 intervention and 14 control, so  $g = 14$ ), and the degrees of freedom  $df = 2(g-1) = 26$ . Two hundred eighty-four youth (9-15 years old) provided information for wave 1 BHCK baseline, and allowing 25% attrition rate at the follow-up, the number of youth per group would equal 19 ( $m=19$ ). The  $t$ -values for Type I and Type II error rates are 2.056 and 0.856, respectively. The estimated group component variance ( $\sigma^2_g$ ) is related to the ICC as:  $\sigma^2_g = (\sigma^2_m \cdot ICC) / (1 - ICC)$ , yielding  $\sigma^2_g = 0.0297$ . Therefore, using Murray's equation, the unadjusted variance estimates are illustrated by equation (2):

**Equation (2):** 
$$\Delta = \sqrt{[(2 \cdot (6.3031 + 19 \times 0.0297) \cdot (2.056 + 0.856)^2) / 19 \times 14]} = 0.37$$

With the actual size of the study ( $n=534$ ), there is 80% power given a two-tailed Type I error of 5% to detect an intervention effect of 0.40 servings of fruit and vegetable among children. Similar multi-level childhood obesity prevention trials have reported similar effect sizes – The Switch trial reported an effect size using Cohen's  $d = 0.52$ .<sup>171</sup> The Shape Up Somerville observed a smaller intervention effect of 0.16 daily servings of fruits and vegetables.<sup>167</sup> Given the aforementioned assumptions, a sample size of 534 child-adult dyads at follow-up is sufficient to detect an effect of the BHCK intervention on fruit and vegetable servings of approximately 0.37.

### ***3.10 Methods of Analysis***

#### ***3.10.1 Formation of variables***

The first stage of analysis involved the development of derived variables. The main variables formed are described below.

*Youth Dietary Intake Variables.* The key variables for youth dietary intake were derived from the Block Kids FFQ. As mentioned above, the BKFFQ was analyzed by NutritionQuest, and patterns of food consumption, macronutrient, micronutrient, and energy intake were obtained. The software company derived daily intake estimates for foods and beverages, and provided the following information relevant to this proposal: total food energy (kcal), total fat (grams), percentage of kcal from fat, percentage of kcal from sweets and desserts, average daily grams of sugary beverages, average daily kilocalories from sugary beverages, dietary fiber from grain (grams), daily servings of vegetables (total cups), daily serving of fruits (including 100% fruit juice, total cups), added sugar (teaspoon equivalents), dietary total sugar (grams), dietary sodium (mg), and whole-grains (ounce equivalents). As nutrient intake distributions are often skewed (due to extremely high intake limits and lower limits of zero), the need for transformation was assessed using Shapiro-Wilk and Kolmogorov-Smirnov tests. Transformations were not needed. Energy adjustment was considered, as there is likelihood of underreporting consumption of food and beverage.<sup>244</sup>

*Youth Food Preparation Behavior.* A healthful cooking score was created using similar methods previously reported by us.<sup>238</sup> Each food preparation method was assigned the following score based on the healthiness of the method and on the amount of fat used:

fried (-1), baked (+1), microwaved (+1), raw (+1), other (0).<sup>238</sup> Total score for each cooking method were averaged and calculated taking into account the number of times food was prepared per week. For example, the number of fried foods prepared was divided by the total number of foods prepared in the past week. If a youth reported preparing in the past week breakfast cereal with milk ('other') and fried bacon ('fried'), the total score for fried food would result in  $-1/2 = -0.5$ . A healthy food preparation score was created by summing the scores of foods prepared using the methods of microwaving, baked, raw, and other. Unhealthy food preparation score represents the method that adds extra fat or oil to the food (frying).

*Youth Food Purchasing Behavior.* Food purchasing were additive variables developed based on the healthier and unhealthier foods listed in **Table 3.3** in terms of variety, frequency, proportion of variety (variety healthier/total foods, variety unhealthier/total foods) and proportion of frequency (frequency healthier/total purchasing frequency, frequency unhealthier/ total purchasing frequency). Itemized Cronbach's alphas assessed the presence of inconsistent variables in the score in order to maintain an alpha higher than 0.6.

For the **healthier food variety variable** (number of different items per week), one point was assigned to each food/beverage item if youth reported purchasing in the past 7 days (regardless of the frequency), or 0 if they did not purchase that item. Then, we summed all the items belonging to "healthier foods" to derive the healthier food purchasing variety variable. Observed healthier food purchasing variety score ranged from 0 to 34, mean 2.6, SD 3.6, Cronbach's alpha: 0.87. **Unhealthier food purchasing variety variable** was created using the same method, ranged from 0 to 19, mean 4.6, SD

0.37, Cronbach's alpha: 0.80. **Proportion of variety of foods** was calculated using the variety score of food items purchased divided by the total number of foods (items) purchased – proportion of healthier food variety mean (SD)  $0.35 \pm 0.2$ , range 0-1; proportion of unhealthier food variety mean (SD)  $0.64 \pm 0.2$ , range 0-1.

The **healthier and unhealthier food purchasing frequency** were additive items based on the acquisition frequency of 38 healthier and 28 unhealthier foods for each respondent, respectively. Healthier food purchasing frequency score ranged from 0-92 times, mean  $4.85 \pm 8.99$ , Cronbach's alpha: 0.81. Unhealthier food purchasing frequency score ranged from 0 to 75 times, mean  $9.13 \pm 10.26$ , Cronbach's alpha: 0.75. The **proportion of purchasing frequency** was calculated using the self-reported frequency (times) in the past week the food item was purchased divided by the total frequency of food purchased – proportion of healthier food frequency mean (SD)  $0.28 \pm 0.3$ , range 0-1; proportion of unhealthier food frequency mean (SD)  $0.71 \pm 0.2$ , range 0-1.

Caregiver Fruit and Vegetable Intake. The key variables for fruit and vegetable intake were developed from the NCI FV screener. The screener data was entered into analysis software that links to a food composition database, and an algorithm assigned daily frequency of use to each food or beverage item. For the frequency of intake value, the standardized mid-point of each category took into account the number of times per day (i.e., '1-3 months' was assigned 0.67, '1-2 times per week' = 0.214, '3-4 times per week' = 0.5, '5-6 times per week' = 0.786, '1 time per day' = 1.0, '2 times per day' = 2.0, '3 times per day' = 3.0, '4 times per day' = 4.0, and '5 or more times per day' = 5.0). Then, portion size estimates were computed according to the 2005 MyPyramid definition of fruit and vegetable cup equivalent (e.g., portion size category 1 for fruit = 0.25 cups,

category 2 = 0.5 cups, category 3 = 1.0 cup, and category 4 = 1.5 cups). **Table 3.4** describes the portion size standardization suggested by the NCI FV screener. To compute the total average daily fruit and vegetable serving size, participants' daily frequency for each food item were multiplied by typical portion sizes according to MyPyramid values, then summed all food items. Daily serving distribution was assessed for skewness, and the need for transformation was assessed using Shapiro-Wilk and Kolmogorov-Smirnov tests.

**Table 3.4:** Adult caregiver daily fruit and vegetable serving portion size standardization

Food	2005 MyPyramid Cup Equivalents for each Portion Size Category			
	1	2	3	4
Juice	0.5	1.0	1.625	2.5
Fruit	0.25	0.5	1.0	1.5
Lettuce Salad	0.25	0.5	1.0	1.5
French Fries	0.2	0.5	0.75	1.3
Other White Potato	0.25	0.75	1.2	2.0
Dried Beans	0.25	0.75	1.25	2.0
Other Vegetables	0.25	0.75	1.5	2.25
Tomato Sauce	0.25	0.5	1.0	1.5
Vegetable Soups	0.3	1.0	1.6	2.25

Source: <https://epi.grants.cancer.gov/diet/screeners/fruitveg/scoring/allday.html>

*Caregiver Food Preparation Behavior.* The caregiver healthier food preparation score was calculated differently than the youth food preparation score, as the question format and response options were different, due to tailoring to the developmental stage of the respondents (adults versus youth). Cooking methods were assigned scores as follow: deep fry or pan-fried with oil (-2); pan-fried, drained or use of cooking spray (-1); not prepared

in the last 30 days (0); pan-fried, drained and rinsed with hot water (+1); broiled/baked, or grilled, or steamed, or boiled, or raw, or microwaved (+2). The top three methods were then weighted taking into account in the following proportion: 60% (for the first method most commonly used), 30% (second method), and 10% (third method).<sup>241</sup> The scores for the eight foods were calculated separately. For example, if eggs were most commonly pan-fried, second most commonly boiled, and third most commonly cooked with cooking spray, the score was calculated as  $(0.60 \times -2) + (0.30 \times 2) + (0.1 \times -1)$  as an indicator of the overall healthiness of egg preparation. A higher score represented healthier preparation methods. The household food preparation score was calculated by the weighted mean score for each food, considering the following proportion: 60% (first method), 30% (second method), and 10% (third method). Then, the score for all of 8 foods were summed to obtain the overall household food preparation score (mean: -0.07 (0.88), range -1 to 2.1).

Caregiver Food Purchasing Behavior. The healthful and less healthful food acquisition variables were additive items based on the acquisition frequency of 33 healthful and 21 less healthful foods for each respondent and divided by 30 to yield a daily frequency score, respectively. For example, if the participant reported purchasing low-fat milk 4 times (roughly 1x/week) and high-fiber cereal 4 times in the past 30 days, then those numbers were summed with the frequency of purchasing for the other healthier foods for the final score. Additive daily healthier food acquisition frequency ranged from 0.6 to 4.8 with a mean of 0.9 (SD = 0.6, Cronbach's alpha = 0.70), and less healthier food acquisition frequency from 0.1 to 10.2 with a mean of 1.3 (SD = 1.1, Cronbach's alpha = 0.70).

Exposure Score. Exposure scores were calculated for each intervention material or activity part of the BHCK program (seeing BHCK logo, seeing shelf-label, participate in a taste test, seeing posters, seeing handouts, receiving giveaways, seeing educational displays, seeing a BHCK carryout menu, shopping in a BHCK store, attending youth-led nutrition education session, interacting with BHCK youth-leaders, following or enrolling in BHCK social media/text-messaging, and seeing BHCK social media posts). In short, as an example related to seeing materials or participating in taste tests, respondents had the option of answering “yes”, “no”, or “maybe” when shown a list of the materials followed by a picture of each item. For each question receiving a “yes” response one point was added, “maybe” was given 0.5 point, and “no” zero points.

Next, points for each intervention component were summed. For instance, we listed 10 possible examples of posters that were added for the total score for “seeing a poster” (possible range: 0-10 points). Possible highest total scores for all intervention components were 107 and 133 for caregivers and children, respectively. Because each intervention material or activity presented different number of questions and yielded different ranges in points, we re-scaled all scores into proportions (possible range 0-1) to apply equal weight to each component in the overall BHCK exposure score. For example, if a participant reported seeing 10 out of the 10 posters, the re-scaled exposure score equals 1; if reported seeing 5 posters the re-scaled score equals 0.5 points for the poster exposure score. Using methods similar to those previously published<sup>239</sup>, overall exposure score was calculated by summing the re-scaled exposure scores of the various BHCK intervention materials and activities. Possible highest re-scaled scores were 11 and 13 for

caregivers and children, respectively, denoting that a 1-unit change in exposure represent a substantial difference in exposure to intervention activities.

### **3.10.2 Descriptive analysis**

Sociodemographic, dietary, and behavioral variables were explored to describe the study population and the distributions of all variables. First, the univariate distributions of the variables were explored in order to examine extreme values (outliers) and identify skewed continuous distributions. Then, the focus was to describe the study population and setting, and to determine the comparability of the baseline characteristics between the two intervention groups. Important variables considered at this stage include: child and caregiver age and sex, anthropometric, child's food and macronutrient intake, caregiver's fruit and vegetable consumption, caregiver education level, household income, food assistance participation, housing arrangement, and household size. If residuals were not normally distributed during model specification checks, a transformation such as the natural logarithm was taken to better achieve normality. The only outcome variable that revealed to be problematic when treating it continuously was the exposure score. In this case, the exposure score was square root transformed. The analyses were then performed on the transformed variables to meet the underlying assumptions of the statistical tests used.

Continuous variables were tested for differences between intervention and comparison groups with independent two-tailed t-tests and analysis of variance (ANOVA). The Chi-square test for proportions was used for categorical variables. In the case that there are significant differences, and it was suspected that the particular characteristic may interfere with the association between the indicator and response



variables of interest, then the characteristic was controlled for in the final regression analysis.

### **3.10.3 Dropouts and missing data**

Exploratory analyses were also conducted to investigate the pattern of dropout rate and missingness of data. Patterns of missing information for diet and food-related behavior were explored by study visit (baseline and follow-up visits), and by treatment group (intervention versus comparison). Dropout patterns were investigated in relation to the baseline outcome measured to assess whether missingness of data was a function of last measurement of the outcome.

BHCK experienced an overall 24.9% attrition rate in our evaluation sample from pre- to post-intervention (wave 1 attrition rate: 31.8%; wave 2 attrition rate: 16.2%). Patterns of missingness was due to the outcome measured at baseline predicting whether subject would return for the follow-up visit or not in terms of caregivers' age (younger caregivers were less likely to return for the post-assessment), caregivers' sex (female caregivers were less likely to dropout), and wave (wave 1 participants were more likely to dropout). Thus, a missing at random (MAR) mechanism was assumed.

An inverse probability weighting (IPW) was used to address potential bias due to loss to follow-up and to correct for the effects of missing data.<sup>245</sup> Using all available data, weights were estimated for every missing outcome of interest fitting a logistic regression model. We treated the categorical indicator of response at follow-up as the outcome variable, regressed on the baseline response for intake, preparation, or acquisition, with caregiver's age, sex, income, wave (predictive of dropout) as covariates. Once the weights were determined, they were incorporated

in the multilevel linear mixed-effect analysis using the *pweight* option for the *mixed* command in Stata.

### ***3.11 Analysis of Specific Aims***

All collected variables were processed in Access (Microsoft, USA). All statistical analyses of the data were conducted using the software Stata IC 13.1 for Mac (StataCorp, College Station, TX, USA 2013). For all analyses, the 95% confidence intervals (C.I.) were reported. Statistical significance was defined by a p-value of  $< 0.05$ .

The primary analysis (Average Treatment Effects) examined the impact of BHCK on the main outcomes (diet and food-related behaviors) comparing pre- and post-intervention using **multilevel linear mixed effects model** to consider the cluster data (families are clustered within recreation center zones). The cluster design assumes that individuals within the same cluster (recreation center zone) are more highly correlated with each other than with people in other clusters. Furthermore, due to the repeated measures (pre and post-assessments), there is also within variation at the individual-level, so independence cannot be assumed in this case, by which statistical analysis should account for the correlations observed. First, to verify this assumption, ANOVA was conducted to extract the F-statistic variable for the calculation of the intraclass correlation coefficient (ICC). As clusters explained the high variance observed in the data, multilevel linear mixed effects models were employed to correct the variance observed due to cluster as the error term in the analysis. Moreover, due to the expected number of missing data (dropout rates  $>20\%$ ), multilevel models are a good approach to be used under the missing at random assumption for missing data, as it models both the means and the

random effect jointly. Thus, multilevel models were the most appropriate approach to address the aims of this proposal given this dataset.

The multilevel model has mixed effect components, as it accounts for both fixed and random effects. The single fixed independent variable is represented by  $\beta$  (level 1 variance), and the random effect  $\mathbf{u}$  represents the random effect to allow each recreation center zone's coefficient ( $\mathbf{u}_{0j}$ ) and random variation among repeated measures in the individual ( $\mathbf{u}_{0i}$ ) to vary randomly at level 2 (cluster). The equation proposed to assess each study hypothesis is represented in Equation (3) below. In this model, the response for the  $j^{\text{th}}$  individual nested in  $i^{\text{th}}$  cluster (recreation center zone) at the  $k^{\text{th}}$  time measure is assumed to differ from the population mean by a within and between random component.

**Equation (3):** 
$$E(Y)_{ijk} = \beta_0 + \beta_1 * (\text{Time})_{ijk} + \beta_2 * (\text{Time})_{ijk} * (\text{Group})_i + \mathbf{u}_{0j} + \mathbf{u}_{0i} + \varepsilon_{ijk}$$

The intervention effects on the mean change in diet and food-related behaviors ( $Y_{ijk}$ ) were assessed by the difference between the mean change of the outcome over time in the intervention group compared to the control group. The sum of the slope ( $\beta_1$ ) multiplied by the time covariate (0= baseline and 1=post-assessment) and ( $\beta_2$ ) multiplied by the interaction term of time and group resulted in the mean change of the outcome over time for the intervention group. The mean change of the outcome over time in the comparison group is given by the slope  $\beta_1$ . Thus, the mean difference between intervention and control groups over time was given by  $\beta_2$ . If the estimate is significant ( $p < 0.05$ ), the null hypothesis (mean dietary and food-related outcomes are equal in the intervention and control groups after the BHCK intervention) was rejected.

### **3.11.1 Patterns and determinants of exposure to BHCK (Paper 1)**

Specific exposure scores of materials and activities, as well as overall BHCK exposure score (continuous variables) were tested for differences between intervention and comparison groups using independent two-tailed t-tests. Differences in exposure scores between wave 1 and wave 2 were also tested using a two-tailed independent t-test.

Then, regression analyses were conducted to investigate whether sociodemographic characteristics of youth and caregivers could account for differences in exposure level that were not due to being assigned to treatment groups. The model specification checks, including assessment of model residuals, revealed that treating the outcome (exposure score) as a continuous variable was problematic. Thus, sensitivity analyses were performed by fitting a quadratic linear regression models (exposure scores were square root transformed) to address the skewness of the dependent variable and to inform interpretation of the ordinal models. Therefore, a categorical version of the variable was used, based on quartiles of the score, in all models.

Bivariate and multiple ordered logit regression models were used to analyze the association between youth and caregiver exposure levels (quartiles) and sociodemographic, household and individual characteristics of the participants. Each model with exposure level (quartiles of exposure) was regressed on different independent variables (youth and caregiver's age (continuous variable) and sex, caregiver's educational level (categorized into less than high school, completed high school, and more than high school (for less than two years of college, associate's degree, bachelor's degree, or beyond) and coded as 0, 1, and 2, respectively), housing arrangement (owned, rent, and shared with family or other arrangement (group housing, and transitional

housing), number of individuals living in the household (continuous variable), and supplemental nutritional assistance program participation, coded as 0 if not enrolled). The exposure level (outcomes of interest) was stratified by quartiles (very low, low, medium, and high), in which we interpret the increase in each quartile as a higher level of exposure to BHCK activities. The final multiple ordinal regression model was selected based on the goodness of best fit using stepwise backward method for lowest Akaike information criterion (AIC).

The ordered logit model assumes that the effect of any of the independent variables is the same regardless of the level (quartile) of exposure (e.g., coefficients describing the relationship between the lowest and all higher scores are the same as those describing associations between the next lowest and all higher scores).<sup>246</sup> The variance inflation factor for each model was calculated to check for collinearity by performing a multiple linear regression, which were all below 1.0. The parallel assumption of the ordered logit regression was investigated by the likelihood-ratio test followed by the Brant Test, in which both tests failed to reject the null hypothesis that the coefficients were equal across quartiles of exposure.

### **3.11.2 Impact of BHCK on youth's diet and food-related behaviors (Paper 2)**

The intervention effects on the mean change in diet and food-purchasing behaviors among youth were assessed by the difference between the mean change of the outcome in the intervention compared to the control groups using a multilevel linear mixed-effect model. The multilevel model had mixed-effect components that accounted for both fixed and random effects. The single fixed independent variable included the time-by-group interaction. The random effect allowed recreation center zone's

coefficients and the random variation among repeated measures in the youth to vary randomly at the group level. The intraclass correlation coefficients (ICC) for the outcome measures at the subject-within-zone level ranged from 0.34-0.13. If the estimate was significant ( $p < 0.05$ ), the null hypothesis (that mean dietary and food purchasing outcomes are equal in the intervention and control groups after the BHCK intervention) was rejected.

Caregiver's age (continuous), and youth's age (continuous, centered at the mean), caregiver and youth's sex, race were added as covariates in the food-purchasing models. In the dietary intake models, we included the following covariates: caregiver and youth age and sex, youth's race, and total daily calorie intake.<sup>244</sup> Sociodemographic variables were included as covariates in final models if they were different at baseline comparing treatment and comparison groups (caregiver and youth ages), predicted dropout (caregiver's age and sex) or were described as a confounding variable in the literature (energy intake for dietary intake).

Missing data were imputed by modeling and estimating both the means and the random effect jointly using all non-missing data in the covariate matrix (maximum likelihood estimation) to address potential bias due to loss to follow-up and to maximize sample size ( $n=508$ ).<sup>245</sup> Impact analyses were also stratified by age category: 9-12 and 13-15-years old.

### **3.11.3 Impact of BHCK on caregiver's diet and food-related behaviors**

#### **(Paper 3)**

The primary impact analysis on the change in fruit and vegetable intake, food preparation, and food-acquisition behaviors among adult caregivers were assessed by the

difference between the mean change of the outcome in the intervention group compared to the control group. The intervention effect on adult caregivers' food-related behaviors was tested using a multilevel linear mixed-effect model fit by maximum likelihood. Random effects accounted for variation at the BHCK zone and at the caregiver-level (repeated measures).

A secondary impact analysis (treatment-on-the-treated effect) was conducted, in which study participants were analyzed according to the treatment received,<sup>193</sup> as estimated by their exposure scores. We conducted multiple linear regression models to analyze the association between the change in caregivers' food behaviors (fruit and vegetable intake, food preparation, and acquisition) and caregiver exposure levels (total exposure score, and by exposure to intervention components), adjusted for age, sex, income, and household size. We used a bootstrap method with 2000 repetitions and bias-corrected confidence intervals to account for the within-individual correlation of the data, clustered on the BHCK zone.<sup>247,248</sup> For the significant results, we estimated the proportion of variability explained (effect size) with omega-squared ( $\omega^2$ ) after fitting the multivariate models. A sensitivity analysis using multiple logistic regression on the correlation between the categorical change in food-related behavior (no change versus positive change) and the exposure scores (low (if 0) versus high (if above 0)) was also conducted to estimate the standardized effect size given by the odds ratio. Given the time frame for follow-up data collection differed by wave, we conducted tests of homogeneity to explore if the effect of exposure was moderated by the two BHCK waves with an interaction term between exposure score and wave.

### ***3.12 Funding***

This thesis was primarily supported by the parent study, BHCK, which was funded by the Global Obesity Prevention Center (GOPC) at Johns Hopkins, and *the Eunice Kennedy Shriver* National Institute of Child Health and Human Development (NICHD) and the Office of the Director, National Institutes of Health (OD) under award number U54HD070725. Additional funds for data collection and analysis of this thesis work from the Centers for Disease Control and Prevention (1U48DP000040, SIP 14-027) was obtained. ACBT was supported by a 48-months predoctoral fellowship from the Brazilian National Council for Scientific and Technological Development CNPq (GDE: 249316/2013-7).

### ***3.13 Ethical Considerations***

The Institutional Review Board at the Johns Hopkins Bloomberg School of Public Health (IRB Number 0004203) approved all components of this thesis and the BHCK parent study.

Signed informed assent and consent were gathered from both the youth and caregiver, respectively. All interviews were conducted in person at a location that was convenient for the participant such as the recreation center, the participant's home, or an office at the Johns Hopkins Bloomberg School of Public Health. To protect privacy, the interviews were conducted in a private or semi-private setting, selected by the participant allowing for information to be provided in a secure fashion and in a comfortable environment. Adult caregivers could participate in the baseline data collection interviews even if they did not give consent for their children to participate in the baseline data



collection interviews (no case). Likewise, they could provide parental permission for their child to participate in the baseline data collection interviews without having to participate themselves (n=1). Participants had the option to withdraw from the interview and from the study at any time and were allowed to refuse to answer any questions they were uncomfortable with. Youth and caregivers received gift cards after each of the two interviews.

In order to ensure security and protection of subject confidentiality, hard copies of data collection materials included an ID code but did not have personal identifiers. However, a code linking the data to the subject's personal information was stored separately from the data collection sheets and was also stored in a secure cabinet or room with limited access by authorized individuals.

## **Chapter 4. Exposure to a multilevel multicomponent childhood obesity prevention community- randomized controlled trial: patterns, determinants, and implications**

### ***4.1 Abstract***

**Objective:** For community interventions to be effective in real-world conditions, participants need to have sufficient exposure to the intervention. It is unclear how the dose and intensity of the intervention differ among study participants in low-income areas. We aimed to understand patterns of exposure to different components of a multilevel multicomponent obesity prevention program to inform our future impact analyses. **Methods:** B'more Healthy Communities for Kids (BHCK) was a community-randomized controlled trial implemented in 30 low-income zones in Baltimore in two rounds (waves). Exposure to three different intervention components (corner store/carryout, social media/text messaging, youth-led nutrition education) was assessed via post-intervention interviews with 385 low-income urban youth and their caregivers. Exposure scores were generated based on self-reported viewing of BHCK materials (posters, handouts, educational displays, social media posts) and participating in activities, including taste tests during the intervention. For each intervention component, points were assigned for exposure to study materials/activities, then scaled into proportions (0-1 range), yielding an overall BHCK exposure score [youth: mean 1.1 (range 0-7.6 points); caregiver: 1.1 (0-6.7), possible highest score: 13]. Ordered logit regression analyses were used to investigate correlates of youths' and caregivers' exposure level (quartile of exposure). **Results:** Mean intervention exposure scores were

significantly higher for intervention than comparison youth (mean 1.6 vs 0.5,  $p < 0.001$ ) and caregivers (mean 1.6 vs 0.6,  $p < 0.001$ ). However, exposure scores were low in both groups and 10% of comparison group was moderately exposed to the intervention. For each 1-year increase in age, there was a 33% lower odds of being highly exposed to the intervention (OR 0.77 95% CI 0.69; 0.88) in the unadjusted and adjusted models controlling for youth's sex and household income. **Conclusion:** Treatment effects may be attenuated in community-based trials, as participants may be differentially exposed to intervention components and the comparison group may also be exposed. Exposure should be measured to provide context to impact evaluations in multi-level trials. Future analyses linking exposure scores to the outcome, should control for potential confounders in the treatment-on-the-treated approach, while recognizing that confounding and selection bias may exist affecting causal inference.

**Keywords:** Process evaluation, childhood obesity, dose received, methods, implementation process, exposure

## **4.2 Introduction**

The multifactorial causes of obesity are well-recognized, and it is clear that no single community program or policy provides a comprehensive solution to this important public health problem.<sup>3,4,145</sup> Thus, multi-level multi-component (MLMC) interventions are suggested to be more effective than single component interventions, due to synergistic effects between multiple intervention components.<sup>146,249</sup> However, in order to achieve these effects, MLMC interventions need to reach the population of interest in sufficient intensity – i.e., achieve adequate exposure. Therefore, evaluation of program implementation need to be systematically measured and evaluated, as it informs research to practice gaps<sup>250</sup> allowing replication in real world settings and large-scale public health dissemination.<sup>251</sup>

Given the importance of implementation to study outcomes, a growing body of literature has used process evaluation to assess intervention fidelity (adherence to intervention protocol).<sup>189,252,253</sup> Process evaluation is used to monitor and improve program delivery and helps explain reasons for failure or success of a trial.<sup>254</sup> Among process evaluation constructs, exposure (‘dose received’) is rarely measured, but allows researchers to understand how well a program reached its intended audience from the participants’ perception of their personal exposure and the extent to which they actively engaged with the research activities and materials.<sup>190</sup>

Few studies have reported assessing the extent to which individual study participants report being exposed to the intervention. A previous environmental obesity intervention trial, Navajo Health Stores, in American Indian reservations developed exposure scores based on participant’s report of study dose received and found a negative

correlation with Body Mass Index (BMI) changes.<sup>239</sup> Another multisite childhood obesity trial, Child and Adolescent Trial for Cardiovascular Health (CATCH), used exposure questionnaires to improve specificity of the intervention and elicit more specific information from intervention components.<sup>255</sup> Baltimore Healthy Eating Zones (BHEZ), a childhood obesity prevention trial conducted at multiple levels in the low-income urban area of Baltimore City, used different components of the intervention to create the exposure score to inform secondary evaluation analysis.<sup>256</sup> The Boost program, a Danish multi-component school-based trial, used measures of exposure as the extent of parental involvement in the intervention, and found that students with a high exposure level consumed more fruits and vegetables daily than those with low exposure score.<sup>192</sup>

Despite different usage of exposure measurements, to our knowledge no study has investigated how exposure level varies by participant characteristics, nor has explored differences in exposure levels between both adult caregivers and their child participants in a multi-level intervention. This could be used to inform the study's external validity and to identify observed confounding characteristics of individuals who would be reached by the intervention at different doses.<sup>257</sup>

This study aimed to identify the patterns and determinants of the different levels of exposure to the B'more Healthy Community for Kids (BHCK) intervention – a community-based randomized childhood obesity prevention trial intervening at multiple levels (corner store, carryout, social media/text messaging, and recreation center youth-led nutrition education) of the food system in low-income urban areas of Baltimore City in two rounds (waves).<sup>11</sup> Specifically, this paper answers the following questions:

1. What were the patterns of exposure (dose received) to BHCK intervention materials and activities among youth and caregivers?
2. How did patterns of overall dose received differ by treatment group among youth and their caregivers?
3. What individual and household factors are associated with exposure to the BHCK intervention?

### **4.3 Methods**

#### **4.3.1 Design and setting**

The BHCK trial was implemented at multiple levels of the urban food environment to improve access to, purchase of, and consumption of healthy food among low-income youths and their families living in food deserts in Baltimore. The BHCK study used a pre- and post-intervention assessment design, with two groups, intervention and comparison, in a 1:1 ratio. The intervention was implemented in two waves (wave 1: August 2014–February 2015 and wave 2: November 2015–August 2016).

The intervention took place in 30 zones, randomized to intervention ( $n = 7$  per wave) and comparison groups ( $n = 7$  wave 1 and  $n=9$  wave 2). Assignment occurred publicly by drawing names of eligible recreation centers from a hat. Recreation centers were the nucleus of each zone. A zone's eligibility criteria in the BHCK trial were: (1) pre- dominantly African American ( $>50\%$ ), (2) low-income neighborhood ( $>20\%$  of residents living below poverty line), (3) minimum of five small food sources ( $<3$  aisles and no seating), and (4) a recreation center more than  $\frac{1}{2}$  mile away from a supermarket. A sample of adult caregiver and child dyads were actively recruited at each recreation

center and nearby corner stores in the 1.5- mile zone buffer by a BHCK data collector.

Household eligibility criteria included: (1) having at least one child aged 10–14 years, (2) having lived in the same location for at least one month, and (3) does not anticipate moving in the next 2 years.<sup>11</sup>

A detailed description of the intervention (including formative research, sample size calculation, and intervention activities) is provided elsewhere.<sup>11</sup> The BHCK intervention included three main intervention components to target youths and their caregivers:

1. nutrition education and cooking classes (14 lessons of 1-hour duration) led by local youth leaders (intensively trained Baltimore college and high school students), which took place every other week at each intervention community recreation center during after-school programs<sup>230</sup>
2. environmental intervention at the point of purchase in small food stores (corner stores) and family- owned prepared-food outlets (carryout restaurants), which sought to increase stocking of healthier options by store owners and encourage demand of healthful foods through promotions and taste tests of healthier foods and beverages by intervention staff, implemented every other week at intervention corner stores and carryout restaurants for sessions lasting up to 2 hours each<sup>225</sup>
3. social media (Facebook and Instagram) and text- messaging communication campaign, which encouraged goal setting for healthy eating targeted at caregivers, delivered up to three times per week (text messages were sent three times a week and included an interactive component and social media posts were made at least three times per week)

Communications materials (i.e., poster, handouts, educational displays, and giveaways) were professionally developed based on formative research and concurrently displayed during BHCK components and distributed to participants every other week in sequence. The intervention was organized in three themed phases lasting for 2 months each: (1) smart drinks, (2) smart snacks, and (3) smart cooking. All material was aligned with the healthy alternative food product and behavior being promoted at each phase.<sup>225</sup>

Study participants were not required to attend recreation center activities nor to visit the BHCK stores and carryouts. However, intervention caregivers were asked if they would like to receive text messages after their baseline appointments and were given a business card with BHCK social media links. In the comparison zones, neither recreation centers nor small food stores received the nutrition education sessions or communication materials, and caregiver– child dyads living in these areas were not enrolled in the BHCK text-messaging program.

#### **4.3.2 Selection and training of data collectors**

Data collectors were trained intensively, through role play and observation training. Group assignments were concealed from the BHCK data collectors who conducted the follow-up assessments. Following the interviews, the data were checked for errors by the interviewer and a second research assistant. The completed questionnaires were examined for missing data or implausible values, and the research team made their best effort to contact the research participants to obtain the needed information.

#### **4.3.3 Measures**

*Caregiver and youth data collection*



Baseline data were collected from July 2013 to June 2014 (wave 1) for a total of 299 youths and their main caregivers (n = 298), and from July to December 2015 (wave 2) for 235 caregivers and their youth.<sup>11</sup> The post- evaluation was conducted from March 2015 to March 2016 (wave 1) and from August to January 2017 (wave 2), taking place immediately after implementation of the intervention and running for 1 year (wave 1) or 6 months (wave 2). Youths and caregivers received gift cards after each of the two interviews. Informed assent and consent were gathered from both the youths and caregivers, respectively.

For the analysis, we excluded participants who did not complete the exposure assessment at the follow-up visit (youths n = 133 and caregivers n = 135), had missing information for at least one exposure variable (youths n = 4 and caregivers n = 6), answered positively to more than three of the red-herring questions (youths n=2 and caregivers n=0), reported living in an un- stable housing arrangement, such as a shelter or transitional housing (youths n = 2 and caregivers n = 2), or lived more than 1.5 miles away from a BHCK recreation center (youths n = 4 and caregivers n = 4). This yielded a total of 385 youths and 386 caregivers for the analytical sample. An overview of enrolment and participant flow is presented in **Figure 4.1**.

*Process evaluation assessment: exposure (dose received)*

The key variables for assessing exposure were obtained from the Intervention Exposure Questionnaire (IEQ) collected as part of the post-intervention assessment for the intervention and comparison groups. To address re- search questions 1 and 2, we conceptualized the pattern of exposure as the aggregated series of exposures for the reported dose received, to different intervention materials and activities implemented

over the course of the program, as assessed by the IEQ. Data collected with the IEQ in wave 1 was used to plan wave 2 intervention modifications.<sup>11</sup> As the waves were implemented 9 months apart, we were able to identify the materials and activities that most of the study sample reported not seeing or not participating in.

The 29-item IEQ included questions to measure exposure to each component of the intervention over the course of program delivery: store and carryout component (16 questions), recreation center (five questions), text messaging (one question), social media (four questions), and program logos and branding (three questions). For visual materials, participants were asked whether they had ever seen the materials during the intervention period (i.e., BHCK logos, posters, handouts, giveaways, educational displays, store shelf labels, and social media posts). For example, the question to assess exposure to BHCK posters was worded: “The BHCK project put up posters in stores, carryouts, and recreation centers. Which of the following have you seen and/or read?” For each item, individuals were shown examples of materials used during the intervention and responded “yes,” “no,” or “maybe.” Because we developed a wide variety of handouts and posters throughout the intervention, we randomly chose a subset of examples in the IEQ to reduce respondent burden.

Only youths were asked about recreation center activities, such as cooking classes held in the center and frequency of recreation center attendance during the year of the intervention. Only adults were asked about participation in the BHCK text messaging and engagement with the social media programs during the year of the intervention, because these intervention components were targeted specifically at caregivers. Only when assessing exposure to the store component did we ask youths and adults to report the number

of times they had shopped in the BHCK intervention corner stores and carryouts in the 7 days prior to the interview to improve the precision of reporting. We showed them pictures of the stores' facades to aid with recall.

In addition, eight red herring questions were used to address response bias. These included materials used in previous studies conducted in different sites. Respondents who answered positively to three (1/3) or more of the red herring questions were excluded from the analysis.

#### *Calculation of exposure scores*

We calculated exposure scores for each intervention material or activity part of the BHCK program (seeing BHCK logo, seeing shelf label, participating in a taste test, seeing posters, seeing handouts, receiving giveaways, seeing educational displays, seeing a BHCK carry-out menu, shopping in a BHCK store, attending a youth-led nutrition education session, interacting with BHCK youth-leaders, following or enrolling in BHCK social media or text messaging, and seeing BHCK social media posts). The detailed coding of the exposure scores is presented in **Table 4.1**. In short, as an example, for seeing materials or participating in taste tests, respondents had the option of answering “yes,” “no,” or “maybe” when shown a list of the materials followed by a picture of each item. For each question receiving a “yes” response one point was added, “maybe” was given 0.5 points, and “no” zero points.

We next added the points for each intervention component. For instance, we listed 10 possible examples of posters. These were added to give the total score for “seeing a poster” (possible range: 0–10 points). The highest total scores possible were 107 and 133 for care-givers and children, respectively. Because each intervention material or activity

had a different number of questions and yielded different ranges in points, we re-scaled all scores (range 0–1) to give an equal weight to each component in the overall BHCK exposure score. For example, if a participant reported seeing 10 out of the 10 posters, their re-scaled exposure score was 1. If they reported seeing five posters, their re-scaled score was 0.5 points. Using methods like those previously published<sup>239</sup>, the overall exposure score was calculated by summing the re-scaled exposure scores of the various BHCK intervention materials and activities. The highest re-scaled scores possible were 11 and 13 for caregivers and children, respectively, such that a 1-unit change in exposure represent a substantial difference in exposure to intervention activities.

#### *Baseline individual and household sociodemographic characteristics*

To address our third research question, we investigated whether the sociodemographic characteristics of the youths and caregivers could account for differences in exposure level that were not due to being assigned to treatment groups. We explored potential individual and household characteristics that could correlate with being exposed to the BHCK intervention, including child's age and sex; caregiver's age, sex, education level, and employment status; and household annual income, housing arrangement, and participation in a food assistance program. To collect this data, we used two instruments, the Child Impact Questionnaire<sup>71,238</sup>, and the Adult Impact Questionnaire.<sup>7</sup> Both questionnaires were adopted from similar instruments used in previous intervention trials in Baltimore City and are based on formative research.<sup>240,241</sup> The Adult Impact Questionnaire included questions on demographics and household socioeconomic information, such as caregiver's age, sex, education level, and employment status (currently employed, retired, disabled, or otherwise not employed); household annual

income (categories US\$0–10,000; 10,001–20,000; 20,001–30,000; or higher); housing arrangement; number of individuals living in the household (continuous variable); and participation in a food assistance program in the past 12 months [received WIC (Special Supplemental Nutrition Program for Women, Infants, and Children) or SNAP (Supplemental Nutrition Assistance Program) benefits].

#### **4.3.4 Data analysis**

The statistical analysis of the data was conducted using software STATA 13.1 (College Station, TX, USA 2013). Means and standard deviations (SDs) were estimated for key baseline descriptors and exposure scores. Differences in continuous variables between the intervention and comparison groups were tested with an independent two-tailed t-test. A chi-square test for proportions was used to examine categorical variables.

Our model specification checks, including assessment of model residuals, revealed that treating our outcome (exposure score) as a continuous variable was problematic. Thus, we performed sensitivity analyses by fitting quadratic linear regression models (exposure scores were square-root transformed) to address the skewness of the dependent variable and to inform interpretation of the ordinal models (Appendices 8.7 and 8.8: **Table S4. 1** and **Table S4. 2**). We, therefore, used a categorical version, based on quartiles of the score, in all models.

Bivariate and multiple ordered logit regression models were used to analyze the association between youth and caregiver exposure levels (quartiles) and sociodemographic, household, and individual characteristics of the participants. Each model with exposure level (quartiles of exposure) was regressed on different independent variables:

- youth's and caregiver's ages (continuous variables)
- youth's and caregiver's sex
- caregiver's educational level: categorized into less than high school, completed high school, and more than high school (for 2 than two years of college, associate degree, bachelor's degree, or beyond) and coded as 0, 1, and 2, respectively
- housing arrangement: owned, rented, shared with family or other arrangement (group housing or transitional housing)
- number of individuals living in the household (continuous variable)
- participation in a supplemental nutritional assistance program: coded as 0 if not enrolled and 1 if enrolled in the past 12 months

The exposure level (outcome of interest) was stratified by quartiles (very low, low, medium, and high), in which we interpret the increase in each quartile as a higher level of exposure to BHCK activities. The final multiple ordinal regression model was selected based on the goodness of best fit using a stepwise backward method for the lowest Akaike information criterion.

The ordered logit model assumes that the effect of any of the independent variables is the same regardless of the level (quartile) of exposure (e.g., coefficients describing the relation between the lowest and all higher scores are the same as those describing associations between the next lowest and all higher scores).<sup>246</sup> We calculated the variance inflation factor for each model to check for collinearity by performing a multiple linear regression, which were all below 1.0. The parallel assumption of the ordered logit regression was investigated by the likelihood-ratio test followed by the Brant test. Neither

test rejected the null hypothesis that the coefficients were equal across quartiles of exposure. For all analyses, statistical significance was defined as  $p < 0.05$ .

#### **4.4 Results**

##### *Characteristics of the baseline BHCK evaluation sample*

No statistically significant differences were found between treatment groups at baseline (**Table 4.2**). The youths were on average 12 years old and most caregivers were female with an average age of 40. Most caregivers reported receiving SNAP in the past 12 months (70%). There were trends towards significance for a higher proportion of participants in the comparison group living with families compared to the intervention group ( $p = 0.1$ ).

##### *Patterns of dose received (exposure) by different components of the BHCK intervention*

Some materials and activities of the BHCK trial appeared to have a higher mean exposure score than others. Care- givers were highly exposed to the BHCK logo, handouts, giveaways, and the social media program (**Table 4.3**).

Although youths also appeared to be highly exposed to the BHCK logo and giveaways, exposure to educational displays was higher than other materials and greater than the mean exposure score among caregivers (**Table 4.4**).

##### *Patterns of overall dose received (exposure) by BHCK intervention groups*

The overall mean exposure to the BHCK intervention was low among adults (**Table 4.3**) and youths (**Table 4.4**). Despite the observed overall low level of exposure to the BHCK (youth: mean 1.1 points,  $SD \pm 1.35$ , median 0.6, minimum 0 and maximum 7.6;

caregiver: mean 1.1 points,  $SD \pm 1.17$ , median 0.75, minimum 0 and maximum 6.7), in the intervention group, both youths and their caregivers demonstrated a significantly higher exposure level score than the control group. **Figure 4.2** illustrates that although most participants in the intervention group had moderate to high exposure to BHCK, about 12% of the comparison group was moderate-to-highly exposed to the intervention.

*Patterns of dose received (exposure) by the two implementation waves*

Preliminary information on the exposure level from wave 1 was used to inform the midcourse evaluation and to improve the reach and intensity of the overall program in wave 2. The midcourse evaluation allowed our research group to devote time and resources to make changes to the materials and intervention activities for wave 2. For instance, posters hung at community sites increased in size and were professionally redesigned to improve the visibility of the materials and intervention messages. Nutrition interaction sessions at corner stores, carryout restaurants, and recreation centers increased in intensity and duration. The quality of pictures and posting frequency were improved on social media platforms, and posts were boosted to the target audience (e.g., specific zip codes in Baltimore City). Finally, we mailed program flyers and promoted BHCK activities to participating households in the intervention during wave 2 to increase the reach and intensity of the promotional materials.

The second wave of the BHCK implementation had an overall higher exposure level score among the evaluation sample compared to the first wave: caregiver<sub>wave 1</sub>  $0.9 \pm 1.1$  vs caregiver<sub>wave 2</sub>  $1.3 \pm 1.2$ ,  $p < 0.001$  (**Table 4.3**) and youth<sub>wave 1</sub>  $2.3 \pm 3.4$  vs youth<sub>wave 2</sub>  $3.8 \pm 3.9$ ,  $p = 0.003$  (**Table 4.4**). Caregivers in wave 2 reported being more exposed to BHCK handouts, giveaways, social media posts, and the redesigned carryout



restaurants menus than caregivers in wave 1 (**Table 4.3**). In wave 2, youths presented higher mean exposure score to the BHCK logo, posters, handouts, and giveaways, and reported attending more often an after-school program assigned to the BHCK intervention than youths in wave 1 (**Table 4.4**).

#### *Correlates of exposure to the BHCK intervention*

The results of the bivariate ordered logit regression analysis between caregivers' characteristics and quartiles of exposure level are presented in **Table 4.5**. We did not find any predictor that was correlated with caregivers' exposure level in the unadjusted model. The adjusted analysis suggested that female caregivers had higher odds of exposure to the intervention (odds ratio OR 1.99; 95% confidence interval CI 1.05; 3.78) compared to male caregivers, after controlling for SNAP participation and housing arrangement.

The bivariate analysis showed that youths' age was significantly associated with odds of exposure. Specifically, the odds of exposure to the intervention decreased by 33% for each additional year of age (OR 0.77; 95% CI: 0.68; 0.86), and this association remained significant after controlling for household annual income and youths' sex in the final multiple model (OR 0.77; 95% CI: 0.69; 0.88) (**Table 4.6**). In addition, youths in households with a higher annual income (>\$30,000) appeared to be more likely to be exposed to the intervention than youths in the lowest income strata (OR 1.82; 95% CI: 1.13; 2.94), although this association did not remain significant after controlling for youth age and sex.

## **4.5 Discussion**

To our knowledge, this is the first study to identify the patterns and determinants of the different levels of exposure to a MLMC childhood obesity prevention trial in a low-income urban setting. We described a detailed protocol of exposure scores evaluated through the IEQ instrument administered at post-intervention assessment for the intervention and control groups.

Exposure scores represented various levels of engagement with the intervention materials and activities, including seeing intervention materials, participating in educational sessions in stores and recreation centers, and receiving text messaging. Exposure to each intervention activity was then scaled (from 0 = not exposed through 1 = fully exposed), and summed to create an overall exposure score (dose received). Although combined exposure scores were low in both evaluation groups, the mean intervention exposure score was significantly higher among the intervention group than the comparison group for youths and caregivers. Low exposure scores have also been shown in previous community intervention trials, including the Navajo Healthy Stores<sup>239</sup> and in the BHEZ study conducted in urban Baltimore.<sup>256</sup> Our exposure analysis also indicated that the comparison sample was exposed to the intervention materials and activities, similar to what was reported in the Navajo Health Stores intervention.<sup>239</sup>

We calculated the exposure score at the completion of wave 1 to inform process evaluation analysis, and this was key in comprehending which components of the intervention were successful and allowed the researchers to improve the intensity and reach of the communication materials and activities. These midcourse improvements between waves were reflected in our results, since handouts, posters, social media posts,

and overall exposure had a slightly higher mean score in wave 2 compared to wave 1. Similarly in the literature, information collected on the exposure to the Active by Choice Today (ACT) and Pathways interventions are other examples of how a process evaluation may be used during the implementation of a program to improve the quality and acceptability of the trial among the target population.<sup>255,258</sup> ACT used exposure findings for midcourse corrections, such as changes to the program curriculum, visual improvements to the program materials, and expansion of staff training to improve the intensity and dose of intervention over the course of the program.<sup>258</sup> Pathways used exposure results from the pilot testing phase to improve the family component of the intervention, as many children reported not attending the Family Fun Night in the intervention group and more than 40% of children in the control group reported exposure to half of the intervention items.<sup>259</sup> Our study supports previous literature indicating that a process evaluation may be used to improve the quality and dose of the intervention implementation and to ensure that it reaches the intended audience. Evaluating exposure during pilot or feasibility studies may provide critical information to researchers to avoid program contamination in the control group, and to maximize the reach and dose of large multi-level community trials.<sup>260</sup>

A potential use of these exposure data is for impact analyses, as it may be hypothesized that individuals more exposed to a behavioral and environmental intervention will be more likely to have positive outcomes compared to those who were less exposed to the intervention over time.<sup>10</sup> In randomized controlled trials, this is also known as the treatment-on-the-treated effect (TTE), in which study participants are analyzed according to the treatment received, instead of the original treatment assigned

(average treatment effects). Although this practice may violate randomization and increase potential biases, and the results may not infer the causal effect of the intervention, it is often used as a secondary evaluation analysis<sup>193</sup> and may provide an upper bound of program effectiveness.<sup>194</sup> For example, the BHEZ trial found that overweight girls who were more exposed to the intervention showed a 3.1 decrease in their BMI percentile over time compared to those with low exposure. A similar result in magnitude and strength was found in the average treatment effects analysis by treatment groups.<sup>256</sup> Another example is the CATCH study, which used the extent of the exposure to the intervention as a covariate to explain the change in the study outcome (serum cholesterol levels) and by substituting the indicator of study treatment with exposure levels as a TTE secondary analysis.<sup>194</sup> Due to the environmental nature of community-based interventions and the high likelihood of participant contamination, a TTE analysis using dose received information may generate an important estimate of the dose–response treatment effects.

Furthermore, it is important to recognize that participants’ sociodemographic characteristics may confound participation in the program activities (exposure), as well as be directly related to the final intervention outcome. We found that the sex of the caregiver, youth’s age, and household income were important factors that were associated with exposure to BHCK. Future analyses should link process evaluation information and outcome data to understand whether individual and household characteristics confound or mediate the relationship between exposure to the intervention and outcome changes in TTE analyses. In addition, a further TTE analysis using the score for exposure to the intervention should be interpreted cautiously as associations rather than intervention

effects, while recognizing that confounding and selection bias may affect causal inference.<sup>261</sup> Understanding how a public health program reaches its target audience in the intended dose is critical, as community-based interventions are usually addressed to a large number of people. Thus, evaluating the interaction between the study participants and the program implementation informs the evaluation of the intervention, the representativeness of the study<sup>262</sup>, and generates hypotheses for future research.<sup>254</sup>

MLMC intervention trials face an additional challenge of partitioning out which specific intervention components had the greatest influence on individual outcomes.<sup>263</sup> However, incorporating exposure measures on outcome analyses may be another use of dose received in complex intervention trials analyses—one that has been used previously.<sup>10</sup> For example, would individuals who were highly exposed to posters and flyers be more likely to increase their knowledge of healthy eating than those with a lower exposure level to communication materials? Addressing this question would provide empirical evidence to the research community on the combination of intervention strategies that would best encourage behavior change among the targeted audience in the context of a multi-level intervention.<sup>264</sup> Lastly, community intervention trials often assume that the intervention protocol was implemented according to the initial standard, but programs are often adapted to the reality of the setting or not reach their intended target population, which may explain away treatment effects on an outcome of interest.<sup>10</sup> Therefore, assessing exposure and other process evaluation measures is essential to providing context to an intervention impact analysis.

A limitation of this study might be the risk of social desirability bias by treatment assignment, and by sex, age, and income, due to the self-report intervention exposure

questionnaire. Some participants may have felt the need to inaccurately report that they have been exposed to certain activities or received BHCK materials. To address this issue, our questionnaire included red herring questions to improve the validity of responses. Moreover, data collectors did not participate in the intervention implementation and were masked to the treatment group to avoid measurement error. Another limitation is that questions related to store purchasing behavior reflected the previous 7 days to the interview, which may have not reflected a habitual week of the interviewee, while other questions reflected the past year. Although the 7-day recall was conducted to improve quality of the report, as it relies on a participant's memory, it may help explain the low exposure level to the intervention in this population. Future research may consider asking exposure questions consistently with the duration of the intervention program to best capture dose received. Furthermore, we did not assess the frequency of exposure to intervention materials (e.g., the amount of time a respondent saw a specific poster during the intervention or the different places the interviewee received a flyer) to minimize recall bias. However, future studies could consider assessing exposure in a longitudinal manner in a random sample (e.g., mid-intervention or after each intervention phase) to aid in midcourse correction and to inform intervention implementation. In addition, there was some overlap in the intervention and control zones, which might help to explain exposure to the intervention in the control group. However, despite this overlap, differences in exposure levels between the intervention and control group were still observed. Furthermore, including only a subset of the intervention communication materials in the questionnaire may have reduced the chance of some individuals recognizing the specific activities conducted during the intervention. Nevertheless,

research staff chose examples of materials that represented the main topics covered during the intervention. Lastly, we classified exposure domains based on the multiple components of the BHCK program, and we assigned similar weights to each domain of interaction with the trial. However, behavior change is complex and occurs differently in subjects, as people may react in varying ways to activities and materials. Thus, differential exposure domains and weights could be assigned depending on the population, intervention, and context in which the program is being implemented.

### *Conclusions*

In conclusion, the BHCK intervention group was differentially exposed to the program components, and the comparison group also received some exposure, though to a lesser degree. The first wave experienced an overall lower score for exposure to the intervention by youths and caregivers compared to wave 2, highlighting the application of process evaluation findings to improve subsequent program reach and intensity. Future community-based environmental intervention trials may consider enrolling larger sample sizes and improving program intensity, as the likelihood of low exposure is high. Furthermore, samples should be selected to maximize exposure differences between the intervention and comparison groups and to minimize the potential for contamination to intervention activities. Our findings are important to implementation science, as they may inform pilot or feasibility trials of future large environmental community interventions prior to the implementation of the main program to better understand how the population perceives the activities and the dose and intensity needed in the setting.

Furthermore, our exposure analysis was key in identifying that some individual (age and sex) and household (income) characteristics correlate to exposure levels to the intervention. Future analyses linking exposure scores to the outcome should control for potential confounders in the TTE approach as a secondary evaluation assessment. Finally, achieving adequate exposure to the intervention from the participants' perception of dose received is critical in environmental interventions to better understand the effectiveness of the intervention, as well as who was most likely to receive the treatment. This manuscript adds to implementation science by proposing a detailed protocol for the development of exposure scores (dose received) evaluated through process evaluation and by informing further impact analysis and intervention successes.



## 4.6 Tables for Chapter 4

**Table 4.1:** Exposure score development by BHCK intervention materials and activities

Intervention Component	Intervention Material or Activity	Coding of Exposure Score
Corner stores and Carryouts Recreation center Social media	<b>Seeing BHCK Logo in different places</b> (stores, recreation centers, carryouts, social media)	None = 0 1-2 places = 1.5 3-5 places = 4 6 or more = 6
Corner stores and Carryouts	<b>Seeing shelf-label</b> in different stores (BHCK corner stores and carryouts)	None = 0 1-2 places = 1.5 3-5 places = 4 6 or more = 6
Corner stores and Carryouts Recreation center	<b>Taste tests</b> (10 questions) (and 4 cooking demos at recreation center – applied to child only)	For <u>each</u> taste test: Yes = 1 Maybe = 0.5 No = 0
Corner stores and Carryouts Recreation center Social media	<b>Posters</b> (10 questions)	For <u>each</u> poster: Yes = 1 Maybe = 0.5 No = 0
Corner stores and Carryouts Recreation center Social media	<b>Handouts</b> (9 questions)	For <u>each</u> handout: Yes = 1 Maybe = 0.5 No = 0
Corner stores and Carryouts Recreation center	<b>Giveaways</b> (17 questions)	For <u>each</u> giveaway: Yes = 1 Maybe = 0.5 No = 0
Corner stores and Carryouts Recreation center	<b>Educational Display</b> (5 questions)	For <u>each</u> display: Yes = 1 Maybe = 0.5 No = 0
Carryout only	<b>Seeing redesigned menu</b> (8 questions)	For <u>each</u> menu: Yes = 1 Maybe = 0.5 No = 0
Corner stores only	<b>Purchased in a BHCK corner store</b> in the past 7 days	Continuous variable: total frequency of purchase summed for all stores (n=21)

**Table 4.1 continues**

**Table 4.1 continued**

Intervention Component	Intervention Material or Activity	Coding of Exposure Score
Recreation center (applied to child)	<b>Average of attendance in a BHCK recreation center</b> (n=7) during the intervention	Never = 0 < 1 time/month = 0.5 1-3 time/month = 2 1-2 times/week = 6 >3 times/week = 12
Recreation center (applied to child)	<b>Participation in a youth-led nutrition session</b>	Continuous variable: total sessions attended (max: 14)
Corner stores and Carryouts Recreation center (applied to child)	<b>Interaction with BHCK youth-leader</b>	Never = 0 1-5 times = 1 6-10 times = 2 10+ times = 3
Social media (applied to caregiver)	<b>Follow or enrolled in BHCK social media</b> (Facebook, Instagram, Texting)	For <u>each</u> account: Yes = 1 No = 0
Social media	<b>Seeing BHCK posts</b> (Facebook or Instagram) (8 questions)	For <u>each</u> post: Yes = 1 No = 0
<b>Overall BHCK Exposure Score</b>		1. Added points within each intervention material/activity according to number of questions 2. Re-scaled exposure to material/activity to 0-1 range 3. Summed all re-scaled exposure scores

**Table 4.2:** Sociodemographic characteristics of the B'more Healthy Communities for Kids baseline evaluation sample

Baseline Individual and Household Characteristics	n	Intervention	Comparison	p-value
Youth		(n=199)	(n=186)	
Sex– female (%)	385	54.7	60.2	0.3
Age (years) - Mean (SD)	385	11.7 (1.4)	11.8 (1.6)	0.3
Caregiver and Household		(n=198)	(n=188)	
Sex – female (%)	386	94.4	90.5	0.2
Age (years) – Mean (SD)	386	39.4 (9.1)	40.5 (9.7)	0.2
Education Level				
< High School (%)	64	33	30	0.9
High School (%)	150	77	73	
> High School (%)	172	88	85	
Individuals in the household - Mean (SD)		4.5 (1.5)	4.5 (1.6)	0.8
Annual Income (US\$)				
0-10,000 (%)	94	25.2	23.4	0.4
10,001-20,000 (%)	90	20.3	26.6	
20,001-30,000 (%)	60	17.2	13.8	
>30,000 (%)	142	37.4	36.2	
Food Assistance Participation				
SNAP (%)	274	71.2	70.7	0.9
WIC (%)	90	23.2	23.4	0.9
Housing Arrangement				
Living w/ family <sup>a</sup> or other <sup>b</sup> (%)	39	7.1	13.1	0.1
Rented (%)	252	66.2	64.4	
Owned (%)	95	26.7	22.3	

*Notes:* SD (standard deviation); SNAP (Supplemental Nutrition Assistance Program); WIC (Special Supplemental Nutrition Program for Women, Infants, and Children)

<sup>a</sup> Living with family who own or rent the house

<sup>b</sup> Other included: transitional housing or group house.

**Table 4.3:** Caregiver exposure to the B'more Healthy Communities for Kids intervention materials and activities by intervention group (n=386)

Caregiver Exposure to BHCK Materials and Activities	Range	Intervention	Comparison	p value
		Mean $\pm$ SD	Mean $\pm$ SD	
Seeing BHCK Logo in different places	0-1	0.31 $\pm$ 0.25	0.13 $\pm$ 0.20	<0.001
Seeing Shelf-Label in different stores	0-1	0.07 $\pm$ 0.20	0.06 $\pm$ 0.21	0.7
Posters	0-1	0.13 $\pm$ 0.20	0.07 $\pm$ 0.14	0.001
Handouts <sup>a</sup>	0-1	0.20 $\pm$ 0.27	0.05 $\pm$ 0.13	<0.001
Giveaways <sup>a</sup>	0-1	0.22 $\pm$ 0.22	0.03 $\pm$ 0.10	<0.001
Educational Displays	0-1	0.09 $\pm$ 0.18	0.07 $\pm$ 0.17	0.3
Seen Redesigned Menus <sup>a</sup>	0-1	0.15 $\pm$ 0.16	0.04 $\pm$ 0.12	<0.001
Taste Tests	0-1	0.04 $\pm$ 0.12	0.05 $\pm$ 0.16	0.6
Purchased in different BHCK corner stores	0-1	0.07 $\pm$ 0.18	0.01 $\pm$ 0.08	<0.001
Followed/Enrolled in Social Media <sup>a</sup>	0-1	0.21 $\pm$ 0.24	0.06 $\pm$ 0.14	<0.001
Seeing Social Media Post	0-1	0.05 $\pm$ 0.13	0.03 $\pm$ 0.13	0.1
<b>Overall BHCK exposure level <sup>†</sup></b>	0-12	1.60 $\pm$ 1.16	0.61 $\pm$ 1.0	<0.001

Notes: BHCK (B'more Healthy Communities for Kids); SD (Standard Deviation)

<sup>a</sup> Statistically significant improvement in mean score from wave 1 to wave 2 (p < 0.05)

**Table 4.4:** Youth exposure to the B'more Healthy Communities for Kids intervention materials and activities by intervention group (n=385)

Youth Exposure to BHCK Materials and Activities	Range	Intervention	Comparison	p value
		Mean $\pm$ SD	Mean $\pm$ SD	
Seeing BHCK Logo in different places <sup>a</sup>	0-1	0.24 $\pm$ 0.3	0.13 $\pm$ 0.20	<0.001
Seeing Shelf-Label in different stores	0-1	0.07 $\pm$ 0.20	0.03 $\pm$ 0.10	0.005
Posters <sup>a</sup>	0-1	0.15 $\pm$ 0.20	0.05 $\pm$ 0.10	<0.001
Handouts <sup>a</sup>	0-1	0.16 $\pm$ 0.23	0.04 $\pm$ 0.12	<0.001
Giveaways <sup>a</sup>	0-1	0.23 $\pm$ 0.24	0.06 $\pm$ 0.14	<0.001
Educational Displays	0-1	0.17 $\pm$ 0.27	0.06 $\pm$ 0.19	<0.001
Seen Redesigned Menu	0-1	0.08 $\pm$ 0.20	0.04 $\pm$ 0.13	0.02
Taste Test/Cooking	0-1	0.12 $\pm$ 0.20	0.03 $\pm$ 0.02	<0.001
Youth-led Nutrition Education	0-1	0.05 $\pm$ 0.12	0.01 $\pm$ 0.09	0.03
Interaction with BHCK Youth Leader	0-1	0.08 $\pm$ 0.20	0.02 $\pm$ 0.10	0.001
Attended BHCK Recreation Center <sup>a</sup>	0-1	0.14 $\pm$ 0.22	0.01 $\pm$ 0.10	<0.001
Purchased in different BHCK corner stores	0-1	0.08 $\pm$ 0.20	0.02 $\pm$ 0.09	0.001
Seeing Social Media Post	0-1	0.05 $\pm$ 0.18	0.02 $\pm$ 0.10	0.05
<b>Overall BHCK exposure level <sup>a</sup></b>	0-13	1.6 $\pm$ 1.54	0.5 $\pm$ 0.83	<0.001

Notes: BHCK (B'more Healthy Communities for Kids); SD (Standard Deviation)

<sup>a</sup> Statistically significant improvement in mean score from wave 1 to wave 2 (p < 0.05)

**Table 4.5:** Caregiver’s correlates of level of exposure to the B’more Healthy Communities for Kids intervention <sup>a</sup>

Determinants of Exposure to BHCK Caregiver and Household	Bivariate Analysis		Final Multivariable Model <sup>b</sup>	
	Odds Ratio (robust SE)	95% CI	Odds Ratio (robust SE)	95% CI
Sex (Reference: Male)	1.81 (0.57)	(0.97; 3.36)	1.99 (0.65)	(1.05; 3.78)*
Age (years)	0.98 (0.01)	(0.97; 1.01)		
Education Level				
< High School	Reference			
High School	0.95 (0.25)	(0.55; 1.62)		
> High School	1.01 (0.27)	(0.60; 1.70)		
Individuals in the household	0.98 (0.06)	(0.87; 1.10)		
Household Annual Income (US\$)				
0-10,000	Reference			
10,001-20,000	0.87 (0.32)	(0.51; 1.51)		
20,001-30,000	0.88 (0.28)	(0.63; 1.87)		
>30,000	0.98 (0.06)	(0.80; 2.12)		
Food Assistance Participation				
SNAP (Reference: non-SNAP)	0.71 (0.14)	(0.48; 1.07)	0.76 (0.15)	(0.51; 1.14)
WIC (Reference: non-WIC)	0.90 (0.19)	(0.59; 1.37)		
Housing Arrangement				
Living w/ family <sup>c</sup> or other <sup>d</sup>	Reference			
Rented	0.93 (0.34)	(0.44;1.93)	0.95 (0.36)	(0.45; 1.99)
Owned	1.52 (0.62)	(0.69; 3.39)	1.51 (0.62)	(0.68; 3.37)

Notes: SE: robust standard error; CI: confidence interval; SNAP (Supplemental Nutrition Assistance Program); WIC (Special Supplemental Nutrition Program for Women, Infants, and Children)

\*p < 0.5

<sup>a</sup> This is an ordered logistic regression on overall BHCK exposure level (quartiles) among adults

<sup>b</sup> Final model selected based on goodness of best fit using stepwise backward regression for lowest Akaike information criterion (AIC): 1185.2

<sup>c</sup> Living with family who own or rent the house

<sup>d</sup> Other included: transitional housing or group house

**Table 4.6:** Youth's correlates of level of exposure to the B'more Healthy Communities for Kids intervention <sup>a</sup>

Determinants of Exposure to BHCK Youth	Bivariate Analysis		Final Multiple Model <sup>b</sup>	
	Odds Ratio (robust SE)	95% CI	Odds Ratio (robust SE)	95% CI
Sex (Reference: Male)	0.74 (0.13)	(0.52; 1.06)	0.80 (0.14)	(0.56; 1.15)
Age (years)	0.77 (0.04)	(0.68; 0.86)*	0.77 (0.05)	(0.69; 0.88)*
Caregiver Education Level				
< High School	Reference			
High School	1.30 (0.32)	0.80; 2.11)		
> High School	1.37 (0.34)	(0.83; 2.25)		
Individuals in the household	0.95 (0.05)	(0.85; 1.05)		
Household Annual Income (US\$)				
0-10,000	Reference		Reference	
10,001-20,000	1.29 (0.31)	(0.79; 2.09)	1.14 (0.29)	(0.69; 1.89)
20,001-30,000	1.66 (0.50)	(0.92; 3.01)	1.38 (0.43)	(0.74; 2.55)
>30,000	1.82 (0.44)	(1.13; 2.94)*	1.52 (0.37)	(0.94; 2.47)
Food Assistance Participation				
SNAP (Reference: non-SNAP)	0.77 (0.16)	(0.51; 1.16)		
WIC (Reference: non-WIC)	1.28 (0.29)	(0.81; 2.01)		
Housing Arrangement				
Living w/ family <sup>c</sup> or other <sup>d</sup>	Reference			
Rented	1.49 (0.43)	(0.85; 2.63)		
Owned	1.85 (0.63)	(0.94; 3.62)		

*Notes:* SE: robust standard error; CI: confidence interval; SNAP (Supplemental Nutrition Assistance Program); WIC (Special Supplemental Nutrition Program for Women, Infants, and Children)

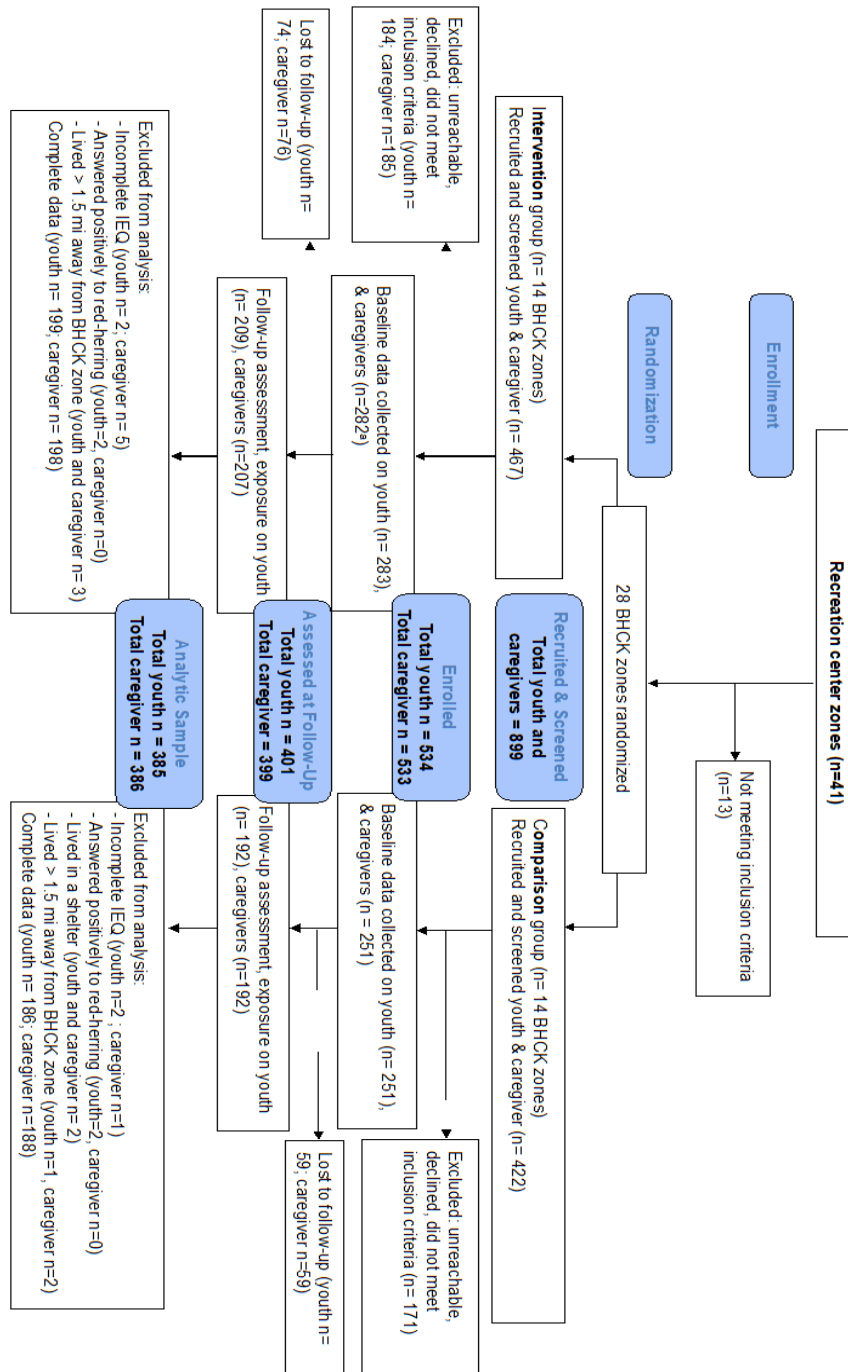
<sup>a</sup> Ordered Logistic Regression on overall BHCK exposure level (quartiles) among youth

<sup>b</sup> Final model selected based on goodness of best fit using stepwise backward regression for lowest Akaike information criterion (AIC): 1057.2

<sup>c</sup> Living with family who own or rent the house

<sup>d</sup> Other included: transitional housing or group house.

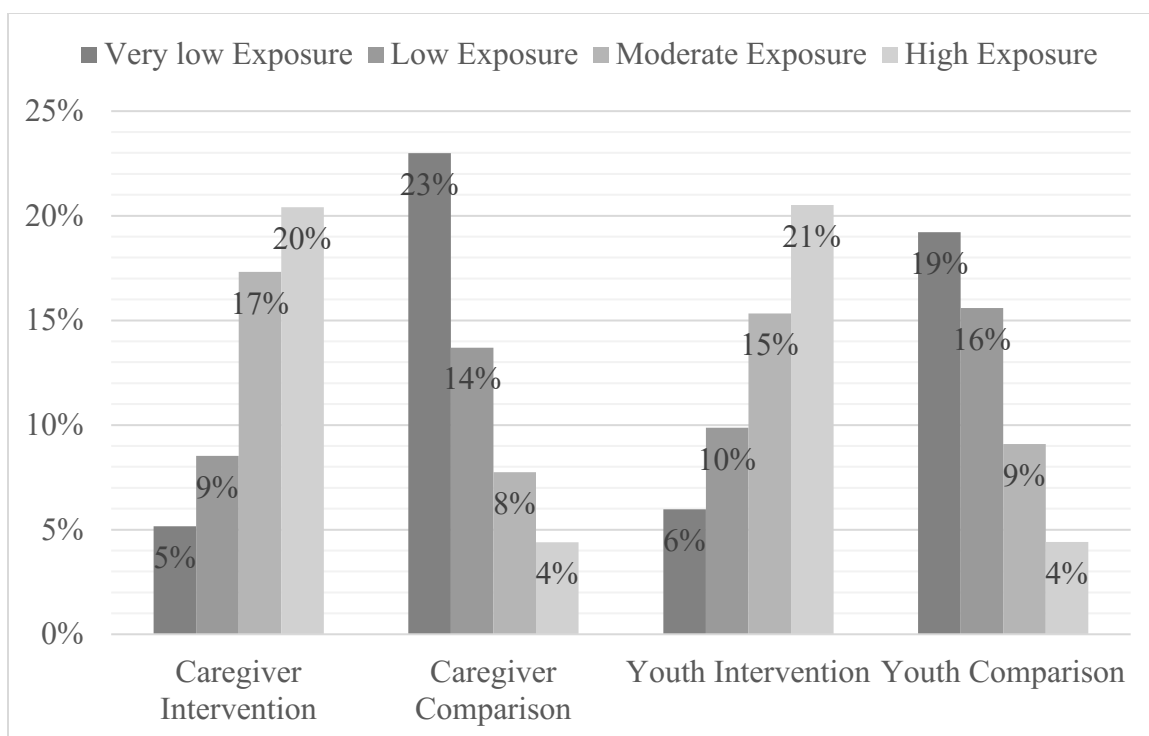
## 4.7 Figures for Chapter 4



**Figure 4.1:** CONSORT flowchart of the randomization and course of the B'more Healthy Communities for Kids program.

<sup>a</sup> One caregiver declined to participate, although consenting participation of their youth.





**Figure 4.2:** Youth and Caregivers' quartile of exposure level by intervention group.

*Notes:* Total exposure score was stratified by quartiles (very low, low, medium, and high). Caregivers' exposure levels of very low ranged from 0 to 0.25 with mean score of 0.08, low ranged from 0.27 to 0.75 with mean score of 0.48, medium ranged from 0.75 to 1.65 and mean score of 1.14, and high ranged from 1.67 to 6.76 with mean score of 2.79. Youth's exposure levels of very low ranged from 0 to 0.18 with mean score of 0.04, low ranged from 0.20 to 0.62 with mean score of 0.36, medium ranged from 0.63 to 1.58 and mean score of 1.0, and high ranged from 1.60 to 7.57 with mean score of 3.0.

## **Chapter 5. A multilevel, multicomponent childhood obesity prevention group-randomized controlled trial improves healthier food purchasing and reduces sweet-snack consumption among low-income African American youth**

### **5.1 Abstract**

**Background:** Consumption of foods and beverages rich in sugar remains high across all races and ages in the United States. Interventions to address childhood obesity and decrease sugar intake are needed, particularly in low-income settings.

**Methods:** *B'more Healthy Communities for Kids* (BHCK) was a group-randomized, controlled trial implemented among 9-15-year olds in 30 low-income areas of Baltimore. We increased access to low-sugar foods and beverages at wholesalers and small food stores. Concurrently, we encouraged their purchase and consumption by children through youth-led nutrition education in recreation centers, in-store promotions, text messaging and a social media program directed at caregivers. Sugar consumption (sugar sweetened beverage (SSB), sweets) in youth was assessed pre- (n=534) and post-intervention (n=401) using the Block Kids Food Frequency Questionnaire. Purchasing of 38 healthier and 28 less healthful foods/beverages varieties in the previous 7 days was assessed via self-report. Multilevel models at the community and individual levels were used. Analyses were stratified by age (younger: 9-12-year olds (n=339) vs older: 13-15 (n=170)). Models were controlled for child's sex, race, total daily calorie intake, and caregiver's age and sex.

**Results:** Overall baseline mean healthier food purchasing was 2.5 ( $\pm$  3.6; min. 0, max. 34 items per week), and unhealthier food purchasing 4.6 ( $\pm$  3.7; 0-19 items per week). Mean intake at baseline for kcal from SSB was 176 ( $\pm$ 189.1) and 153 ( $\pm$ 142.5), and % of calories from sweets (i.e. cookies, cakes, pies, donuts, candy, ice cream, sweetened cereals, and chocolate beverages) was 15.9 ( $\pm$  9.7) and 15.9 (+ 7.7) in comparison and intervention youth, respectively. Intervention youth increased their purchasing of healthier foods and beverages by 1.4 more items per week than comparison youth ( $\beta$  = 1.4; 95% CI: 0.1; 2.8). After the intervention, there was a 3.5% decrease in kcal from sweets for older intervention youth, compared to the control group ( $\beta$  = -3.5; 95% CI: -7.76; -0.05). No impact was seen on SSB consumption.

**Conclusion:** BHCK successfully increased healthier food purchasing variety in youth, and decreased % calories from sweet snacks in older youth. Multilevel, multicomponent environmental childhood obesity programs are a promising strategy to improve eating behaviors among low-income urban youth.

**Keywords:** Consumption of sweets, adolescent, environmental intervention, African-American, dietary intake, childhood obesity

## **5.2 Introduction**

The diet of youths today, especially in low-income, underserved urban populations, is high in refined carbohydrates, added sugar, fats, and salt.<sup>2</sup> Sugar intake is an important risk factor for diet-related chronic diseases, such as overweight and obesity<sup>60</sup>, type-2 diabetes<sup>61</sup>, and poor dental health.<sup>62</sup>

A recent meta-analysis of cohort studies in children reported a significantly increased risk of being overweight or obese with consumption of one or more daily servings of sugar-sweetened beverages (SSBs).<sup>60</sup> Although SSB consumption has declined slightly over the past decade, intake remains high, especially in youth, representing 10-15% of total caloric intake.<sup>63</sup> Importantly, African-American and Hispanic youth had greater increases in calories from sugar per capita than their white counterparts over the past three decades.<sup>40</sup> In addition, a recent nationally-representative study reported no decline (at 14% of total energy intake) in the percentage of the total energy intake from added sugar in U.S. children in the past decade, when considering both foods and beverages intake.<sup>64</sup> These findings suggest that foods such as grain-based desserts, candy, and other sweet snacks are important contributors of added sugar in children's diet.<sup>265</sup> Children with higher intake of sugary beverages tend to snack more often than those with lower.<sup>65</sup> Furthermore, snacking patterns have changed in the past decade, as low-income children increased purchase and consumption of foods high in sugar<sup>66</sup>, and increased consumption of foods away from home.<sup>67</sup> Snacks may significantly contribute to daily caloric intake, surpassing 27% of total daily calories among U.S. children aged 2-18.<sup>65</sup>

Dietary patterns are strongly influenced by a person's food environment.<sup>23</sup> Food marketing and advertisements of unhealthful foods disproportionately target low-income minority populations.<sup>266</sup> Previous studies suggest that living in low-income areas where access to healthy food is limited increases risk of poor diets and obesity.<sup>106,107</sup> Low-income individuals tend to live closer to small food stores with less availability of healthful foods and greater access to high-energy density food of low nutritional value, and increased portion sizes.<sup>267</sup> In Baltimore, low-income African-American youth reported visiting small food stores on average twice a day and buying chips, candy, and soda 2.5, 1.8, and 1.4 times per week, respectively.<sup>116</sup> In Philadelphia, 42% of low-income school-aged children shopped at corner stores twice a day, purchasing 350 calories each visit in candy, chips and SSBs.<sup>117</sup>

Given the patterns in access to and marketing of unhealthful foods in low-income urban areas and the negative health outcomes associated with their consumption, there is a need to improve the community food environment. Due to the complex nature of eating behavior, solutions at the different levels of the socio ecological model (i.e., multilevel) paired with simultaneous actions at the various components of the food environment (i.e., multicomponent) provide a promising population-based approach to leverage the food systems to promote health. Community-based intervention trials aiming at changing the food environment in and around the individual by improving availability, accessibility, and affordability of healthier foods at the community-level and concurrently improving demand and health literacy at the individual-level may be effective in reducing intake of high-sugar, high-fat beverages and snacks. The Shape Up Somerville (SUS) is one example of community-based multilevel multicomponent obesity prevention program

that partnered with restaurants and farmers' market to improve availability of healthy menu options<sup>268</sup>, and successfully increased availability of healthy foods in schools' food service.<sup>165</sup> SUS found a statistically significant decrease in Body Mass Index (BMI) z-scores in children<sup>269</sup>, and reduction in SSB intake after 2 years of intervention.<sup>167</sup>

However, most community-based interventions have promoted healthier food alternatives at food stores targeting adults<sup>270</sup>, and most multilevel interventions have been primarily school-based, targeted elementary- and middle-school -aged children<sup>271</sup>, and few have demonstrated an impact on sugar intake or measured purchasing behaviors.<sup>146</sup> Thus, there is a need for community-based intervention trials that target older children and adolescents.<sup>271</sup> Furthermore, previous longitudinal studies have reported important differences in food patterns across youth ages, with older youth (>12 years old) snacking and purchasing foods out of the home more frequently than younger youth.<sup>177</sup> Therefore, it is important to investigate impact of nutrition interventions at different ages due to different food behaviors and societal eating norms, increased caloric intake, and changes in body composition.

The *B'more Healthy Communities for Kids* (BHCK) intervention was a multilevel multicomponent childhood obesity prevention trial in Baltimore City that sought to modify the food environment outside of school.<sup>11</sup> Components of the intervention aimed at improving availability of healthier alternatives to high-sugar, high-fat beverages and snacks in small food stores and at increasing demand for these items through youth-led nutrition education sessions in recreation centers to impact purchasing and consumption of healthier foods in youth (9-15 years old). This research addresses the following questions:

1. What was the impact of the multilevel BHCK intervention on purchasing behavior of healthier and unhealthier food items among youth?
2. What was the impact of the intervention among youth on the consumption of high-sugar, high-fat snacks and beverages?
3. How did the impact of the intervention differ between younger (9-12 years old) and older youth (13-15 years old)?

### **5.3 Methods**

#### **5.3.1 Study design and sampling**

The BHCK intervention was a five-year funded multilevel, multicomponent childhood obesity prevention trial in Baltimore.<sup>11</sup> The intervention employed a group-randomized controlled trial design implemented at multiple levels of the urban food environment (policy, wholesalers, corner stores, carryout restaurants, recreation centers, and social media) to improve healthful food access, purchase, and consumption among low-income youth aged 9-15 and their caregivers living in food deserts in Baltimore City. The study used pre- and post-intervention assessment design, with two groups – intervention and comparison – implemented in two waves (wave 1: July 2014-February 2015; wave 2: December 2015-July 2016) (**Figure 5.1**).

BHCK took place in 30 zones, randomized to intervention (n= 7 in wave 1; n=7 in wave 2) and comparison groups (n= 7 in wave 1; n=9 in wave 2), using simple randomization. Assignment occurred publicly by drawing names of eligible recreation centers from a hat. A recreation center was at the nucleus of each zone, and zone's eligibility criteria were: 1) predominantly African-American (>50%); 2) low-income

neighborhood (>20% of residents living below the poverty line); 3) minimum of 5 small (<3 aisles, no seating) food sources; 4) recreation center more than ½ mile away from a supermarket, and located in a food desert.<sup>214</sup>

A sample of adult caregiver and child dyads were recruited at each recreation center and nearby corner stores in the 1.5-mile BHCK buffer zone. In each buffer zone, BHCK research assistants approached children and their caregivers about the study, and interested individuals provide their names and phone numbers. A list of 75-100 names per zone was entered into a sampling frame, with the goal to randomly select 20 dyads from each zone. Household eligibility criteria included: (1) at least one child in aged 9-15 years; (2) living in the same location for at least one month; and (3) not anticipating a move in the next 2 years.<sup>11</sup> If a randomly selected dyad was unable or deemed ineligible to participate, then the next dyad was contacted and screened. During wave 1 baseline, the sampling frame for each zone was exhausted, as many individuals initially approached in the community were not eligible or unreachable by phone. Therefore, recruitment of wave 2 baseline households did not follow a random sampling frame and all individuals approached were contacted, screened, and invited to participate in the study. An overview of study enrolment and participant flow is provided (see **Figure 5.2**). Groups assignments were concealed from the BHCK research assistants, who conducted the follow-up assessments.

### ***5.3.2 Promotion of healthful alternatives to beverages and snacks in the BHCK intervention***

The BHCK intervention was divided into three phases, each lasting two months: 1) healthful beverages, 2) healthful snacks, and 3) healthful cooking methods. A fourth



phase (review) was implemented in 2 only. During the healthful beverages phase, the program promoted healthier alternatives to SSBs [i.e., lower-sugar fruit drinks (25-75% less sugar than the original version), sugar-free drink mixes, zero-calorie flavored water, diet or low-sugar soda, and water] as part of each component (social media, small food stores, recreation center, youth-leader, wholesaler, policy) across all levels (individual, household, environmental, and policy). During the healthful snacks phase, BHCK promoted low-fat and low-sugar alternatives to unhealthier snacks, including low-fat yogurt, low-fat popcorn, fresh fruits, fresh vegetables, low-sugar granola bars, and mixed fruit in 100% fruit juice. In the healthful cooking phase, the intervention promoted cooking ingredients, such as low-sugar cereals, low-fat milk, 100% whole wheat bread, fresh/canned/frozen vegetables across all BHCK components.

BHCK encompassed 4 different socioecological levels – policy, environmental, interpersonal and intrapersonal – as well as multiple components involving wholesalers, small food stores (corner stores and carryout restaurants), recreation centers/peer-mentors, and social media. The BHCK components are described below.

*Wholesaler:* We partnered with three wholesalers in Baltimore City, and each was encouraged to stock BHCK-promoted food items. Foods and beverages were promoted through signage, in which a shelf-label was placed by a BHCK-interventionist in the wholesale stores highlighting the promoted item to storeowners.<sup>225</sup> Wholesalers also provided a \$50 gift card to small stores participating in the program at the beginning of each phase to encourage initial stocking of a new promoted item (funded by BHCK).

*Corner Stores and Carry-out Restaurants:* We recruited 3-4 corner stores and carryout restaurants in each BHCK zone. We worked with storeowners in intervention

zones to improve supply and demand for healthier options of food and beverages.<sup>225</sup> Small retailers were provided with gift cards from wholesalers, a stocking sheet with the promoted items, and were encouraged to stock at least one new promoted item every other week. Moreover, storeowners watched six training videos that provided information about the program, how to best improve customer relations, and use of healthier cooking methods (carryout owners only).<sup>227</sup> After completing each training module, owners were offered store supplies as a reward, ranging from produce baskets to refrigerators. To increase demand for healthier alternatives, we used materials and incentives (point-of-purchasing promotion and giveaways), and in-store taste tests, for example, fruit flavored water, baby carrots, and low-sugar granola bars, during two-hour educational sessions (delivered every other week in each intervention store by BHCK-interventionists). Posters and handouts promoting the food items were placed in all intervention stores.

*Recreation Centers:* prior to the intervention, youth leaders (Baltimore City college students) were trained by BHCK-interventionists in leadership and nutrition to conduct educational sessions in 14-intervention recreation centers with children through a peer-intervention approach.<sup>228</sup> Youth leaders were involved in the delivery of the intervention based on the perspectives of Social Cognitive Theory, as a way to enable mentees to model mentors' health behavior.<sup>229</sup> Fourteen sessions implemented every other week (total of 6 months) by youth leaders followed the themes of each BHCK phase. Nutrition sessions lasted one hour, during which youth leaders implemented the BHCK nutrition curriculum with hands-on activities related to the different sugar and fat content in each drink and snack, and introduced a traffic light labeling method for beverages and snacks.<sup>230</sup> Giveaways and taste-tests were also conducted at the end of

each session that aligned with the lesson. All children in the 9-15-year range attending the after-school program at the time of the intervention could participate in the nutrition education sessions. Although recruitment also occurred in recreation centers, study participant youth were not required to attend intervention sessions.

*Social Media and Texting Program:* Social media (Facebook, Instagram, and Twitter) was used to integrate all levels of BHCK and targeted caregivers.<sup>231</sup> Recipes, news, and BHCK-specific activities related to healthier beverages and snacks were featured daily. The text message platform targeted mainly the caregiver level with goal setting strategies and BHCK educational activities for the specific BHCK zone. During each phase, caregivers received a text message 3 to 5 times a week related to healthier eating behavior. A text message example was: “*Water is much better than soda, but it doesn't have 2 be boring. Try squeezing lemons or lime to add natural flavor & help u refresh this 4th of July weekend*”.

*Policy:* We worked with key city stakeholders to support policies for a healthier food environment in Baltimore, and to sustain BHCK activities. In addition, BHCK provided evidence-based information to support the development of policies at the city level using Geographic Information System (GIS)/System Science simulation model to simulate impact to aid stakeholder decision-making (e.g. urban farm tax credit, mobile meals, SSB warning labels).<sup>223</sup>

Study participants were not required to attend recreation center activities, nor to visit the BHCK stores and carryout restaurants. In-store and recreation center nutrition sessions were open to the public and delivered to anyone who was present at the time the intervention was delivered. However, only intervention caregivers were invited to enroll

in text-messaging social media after their baseline appointments. In the comparison zones, neither recreation centers nor small food stores received the nutrition education sessions or communication materials, and caregiver-child dyads living in these areas were not enrolled in the BHCK text-messaging program. Thus, we believed that BHCK would reach its intended population by intervening in multiple settings that are key components of the community food environment.

### ***5.3.3 Selection of BHCK promoted snacks and beverages***

Promoted beverages and snacks qualified as *healthier* in the BHCK intervention were selected based on formative research and focus group discussions held with youth within the targeted age group.<sup>222</sup> These healthier alternatives were selected to be comparable in both flavor profile and price point to snack foods youth would normally purchase and consume. *Healthier* snacks and beverages in our study contained no more than 10% of the daily-recommended value for fat (i.e., below 6.5g of fat per serving), 10g of sugar per serving, and/or were good sources of fiber. These included low-fat string cheese, low-fat yogurt, low-sugar granola bars, fresh fruit, fruit cups in 100% juice, applesauce, sliced apples, popcorn, pretzels, baked chips, water, and low-sugar beverages. *Unhealthier* foods were snacks and beverages low in fiber and high in sugar, starch, and fat (i.e., above 6.5g of fat and/or 10g of sugar per serving), including baked goods, chocolate and non-chocolate candy, crackers, snack chips, soda, fruit punch, and sweetened tea.

### ***5.3.4 Training of interventionists and data collectors***

BHCK-interventionists were graduate students, public health educators, or dietitians trained in nutrition and health education. Data collectors, graduate students and staff,

were trained intensively, including through role play and observation. They were masked after assignment to intervention. Youth and caregivers received gift cards after each of the two interviews. Informed assent and consent were gathered from both the youth and caregiver, respectively. Following the interviews, data were checked for errors by the interviewer and a second research assistant. The data manager ensured that questionnaires had no missing pages or implausible values.

### **5.3.5 Measures**

#### *Youth data collection*

Baseline data were collected from June 2013 to June 2014 (wave 1) in a total of 299 youth and 298 caregivers, and from April to November 2015 (wave 2) in 235 caregiver-youth dyads.<sup>11</sup> Post-evaluation was conducted from March 2015 to March 2016 (wave 1) and from August 2016 to January 2017 (wave 2). We did not analyze participants who had missing information for at least one outcome variable at baseline (n=19), reported living in unstable housing arrangements such as in shelters or transitional housing (n= 2), lived more than 1.5 miles away from a BHCK recreation center (n =4), or were considered an outlier for reported daily energy intake<sup>272</sup> (<500 kcal/day or > 7000 kcal/day) (n=10), yielding a total of 509 with complete baseline and 366 follow-up information for the analytical sample.

#### *Youth purchasing behavior*

Food purchasing behavior was assessed pre- and post-intervention (from 6-12 months after baseline). We used the Child Impact Questionnaire (CIQ)<sup>71,238</sup> to collect food-related information in youth. The CIQ contains 79 questions pertaining to youth food

purchasing habits, along with demographics.<sup>71,238,239</sup> The questionnaire was adapted on the basis of formative research from previous intervention trials in Baltimore.<sup>240,241</sup> We pilot tested the questionnaire with youth (n=20) for clarity and relevance of the instrument items.

We asked respondents to report what foods and beverages they obtained for themselves from different sources (e.g. corner stores, supermarkets, convenience stores, school, vending machines) in the 7 days prior. A list of 38 BHCK-promoted healthier foods and beverages and 28 unhealthier foods and beverages was provided. Foods and beverages included in each category, and information on the healthier and unhealthier food purchasing variety score development are described in **Table 5.1**. Using methods similar to those previously published<sup>216,256</sup>, variety was defined as the total number of different food and beverage products (regardless of their sizes and flavors) assigning one point per purchase of each item in prior week.

#### *Youth food and beverage intake*

The Block Kids 2004 Food Frequency Questionnaire (BKFFQ) instrument was used to collect sugar, fat, beverage, and snack intake in youth.<sup>232</sup> This is a semi-quantitative questionnaire, validated in adolescent populations<sup>232,233</sup> that ascertains the previous week's frequency (from 'none' to 'every day') and consumption amount of 77 common food items (with three to four categories related to food type). It contains foods identified by NHANES II commonly consumed by youth. Completed FFQs were analyzed by Nutrition Quest (Berkley, California, USA) for each youth.

Daily fruit and vegetable intake were estimated in cup-equivalent servings. Vegetable servings exclude potatoes and legumes, and fruit servings include 100% fruit juice. NutritionQuest also calculated the daily sugary beverage intake in kilocalories, and added sugars (sugars and syrups that are added to foods during processing or preparation) in teaspoon-equivalents. Percentage of kcal from sweets was calculated as total kcal coming from sweets and grain-based desserts (sweet cereal, ice cream, cookies, donuts, cake, chocolate candy, other candy, chocolate milk, pudding flan) divided by the total kcal from the whole diet as the denominator. The food groups for the BKFFQ database were developed using National Health and Nutrition Examination Survey (NHANES) and the USDA's My Pyramid Equivalents Database 2.0 (MPED).

### *Covariates*

Sociodemographic characteristics of youth and their caregivers were collected at baseline and post-evaluations using the Child Impact Questionnaire (CIQ) for youth's age and sex, and the Adult Impact Questionnaire (AIQ)<sup>7</sup> for caregiver and household information. The AIQ included questions on demographics and household socioeconomics: caregiver's age (continuous variable), sex, education level (categorized into < high school, completed high school, and > high school), household annual income (US\$0-10,000; 10,001-20,000; 20,001-30,000 or higher), housing arrangement (owned, rent, and shared with family or other arrangement (group housing, transitional housing)), number of individuals in the household, and food assistance participation (received WIC (Special Supplemental Nutrition Program for Women, Infants, and Children) or SNAP (Supplemental Nutrition Assistance Program) benefits in the past year). Sociodemographic variables that were

statistically different at a p-value  $<0.10$  between intervention and comparison groups were included in adjusted effect models as potential confounders.

### **5.3.6 Power calculation**

The BHCK study was powered to detect a difference in healthy food purchasing score of 4-5 items per week, between intervention and control groups.<sup>11</sup> We drew upon our previous study baseline data on adult food purchasing to address the proposed hypothesis.<sup>273</sup> To estimate the sample size and the detectable difference estimate, an analysis was conducted prior to implementation of BHCK accounting for 30 recreation center zones (unit of randomization), controlling for a power of 80% ( $1-\beta$ ) and a probability of a type I error of  $\alpha=0.05$  (two-sided), and assuming a 20% drop-out after two years.

### **5.3.7 Data analysis**

Statistical analysis was conducted using Stata 13.1 (College Station, TX, 2013). Means and standard deviations (SD) were estimated for key baseline descriptors. Continuous variables were tested for differences between intervention group and comparison group with independent 2-tailed t-test, and the Chi-square test for proportions was used for categorical variables.

The intervention effects on the mean change in diet and food-purchasing behaviors were assessed by the difference between the mean change of the outcome in the intervention compared to the control groups using a multilevel linear mixed-effect model. The multilevel model had mixed-effect components that accounted for both fixed and random effects. The single fixed independent variable included the time-by-group



interaction. The random effect allowed recreation center zone's coefficients and the random variation among repeated measures in the youth to vary randomly at the group level. The intraclass correlation coefficients (ICC) for the outcome measures at the subject-within-zone level ranged from 0.34-0.13. If the estimate was significant ( $p < 0.05$ ), the null hypothesis (that mean dietary and food purchasing outcomes are equal in the intervention and control groups after the BHCK intervention) was rejected.

Caregiver's age (continuous), and youth's age (continuous, centered at the mean), caregiver and youth's sex, and race were added as covariates in the food-purchasing models. In the dietary intake models, we included the following covariates: caregiver and youth age and sex, youth's race, and total daily energy intake.<sup>244</sup> We found statistically significant differences between youth who were retained in the intervention versus those lost to follow-up in terms of their caregiver's age and sex. Missing data were imputed by modeling and estimating both the means and the random effect jointly using all non-missing data in the covariate matrix (maximum likelihood estimation) to address potential bias due to loss to follow-up and to maximize sample size ( $n=509$ ).<sup>245</sup> Therefore, to control for selection bias, all models were controlled for these variables. Impact analyses were also stratified by age category: 9-12 and 13-15 year olds.

This study was approved by the Johns Hopkins Bloomberg School of Public Health Institutional Review Board (IRB #00004203).

## **5.4 Results**

Each component of the BHCK program was evaluated through detailed process evaluations reported elsewhere. Overall, the environmental component (wholesaler,

corner store, and carryout restaurants), policy, and the nutrition-education component (youth-led recreation center sessions) were implemented with moderate-to-high reach, dose delivered, and fidelity.<sup>225,226,230,231,274</sup>

#### *Baseline characteristics of the BHCK youth sample*

The vast majority of our study sample self-identified as African-American (overall average 96.6%), and 49% of youth were either overweight or obese (**Table 5.2**). Most youth were from a household that received SNAP (70.8%), with a female primary caregiver (93.2%). Majority of caregivers were considered mothers (79.6%), followed by grandparents (8.6%), and fathers (6.0%). Significant differences were found between treatment groups with respect to youth age categories, with the proportion of older youth (13-15 years old) being somewhat higher in the intervention group ( $p=0.03$ ), and youth's caregiver age ( $p=0.02$ )

#### *Impact of BHCK intervention on purchase of healthier and unhealthier food by youth*

We found a significant positive effect of the intervention on the variety of healthier food purchased among intervention youth versus comparison youth (**Table 5.3**). Overall, youth in the intervention group increased their purchasing by 1.4 more healthier foods and beverages per week than comparison youth ( $\beta=1.4$ ; 95% CI: 0.1; 2.8), after controlling for caregivers' age and sex, youths' age, sex, race, and household receipt of SNAP.

Youth between 9-12 years old at baseline in the intervention group purchased 2.8 greater healthier food items per week, and 1.5 greater items per week of unhealthier foods

over time, when compared to youth in the comparison group (change in number of different items per week of healthier food purchasing:  $\beta=2.8$ ; 95% CI: 0.9; 4.6; items per week of unhealthier food purchasing:  $\beta=1.5$ ; 95% CI: 0.1; 3.0). There was no impact on food purchasing behavior among the older youth in the stratified analysis.

#### *Impact of BHCK intervention on dietary intake in youth*

We found a significant effect of the BHCK intervention on the decrease in % of kcal from sweet snacks and desserts (i.e. cookies, cakes, pies, donuts, candy, ice cream, sweetened cereals, and chocolate beverages) among older intervention youth (13-15 years) compared to older control youth ( $\beta = -3.5$ ; 95% CI: -7.0; -0.1) (**Table 5.4**). We did not find a statistically significant change in SSBs (total kcal or daily ounces), and fruits and vegetables (daily serving) between intervention and control youth over time.

### **5.5 Discussion**

To our knowledge, this is the first study to evaluate youth dietary behavior changes that resulted from a randomized, multilevel community-based (non-school setting) obesity prevention trial in a low-income urban food desert setting. After the BHCK intervention, youth in the intervention group purchased almost 1.5 additional types of healthier food/beverage items per week, compared to their counterparts. This finding is supported by our other results, as BHCK was successful in improving availability of healthier foods and beverages in small food stores in intervention zones<sup>275</sup>, indicating that food availability and promotion at the point-of-purchase may shape people's food choices. Few community-based interventions have assessed the impact of the program on food purchasing behaviors in youth. For instance, a previous trial implemented in Baltimore

with a similar study population did not find an impact of the intervention on food purchasing behavior among youth.<sup>256</sup> Researchers attributed the lack of intervention effect on their limited ability to make changes at the structural level. Conversely, the BHCK trial was one of the first studies to involve wholesalers to guarantee healthier food availability throughout the food supply chain.<sup>225</sup> Partnering with three wholesalers in the city was one of the innovative approaches used by BHCK to ensure that storeowners would be able to find and stock promoted foods and beverages, and may have led to greater, more sustained changes in the food environment.

The age-stratified analysis demonstrated that BHCK decreased kcal intake from sweet snacks among older youth in the intervention group by 3.5% compared to their counterparts. This is encouraging, given that sweet snacks are among the most frequently purchased items by youth in corner stores.<sup>116,117</sup> Youth have almost doubled sweet snack intake in the past three decades, and it is among the main sources of added sugar intake in U.S. children.<sup>265,276</sup>

Another multilevel childhood obesity intervention trial that was implemented in low-income communities in Travis County, Texas (CATCH) found a 0.6 lower unhealthful food index consumption (i.e. fatty meats, fried meat with a crust, French fries/chips, white bread, fruit punch, sodas, frozen desserts, sweet rolls/cake, chocolate candy, and other candy) among middle-school aged children in the school-plus-community arm, compared to school-only intervention.<sup>277</sup> A four-year childhood obesity intervention with Swedish youth that restricted access to sweets and SSBs in the school food environment was also successful in decreasing sweets intake among youth and their families.<sup>278</sup> Compared to younger youth, older youth have an overall lower dietary

quality<sup>279</sup>, experience greater autonomy, and may be more influenced by the community food environment.<sup>280</sup> Therefore, efforts to improve the community food environment may be effective in changing dietary patterns in older youth and adolescents.

There was no significant intervention effect on fruit and vegetable consumption and SSB intake among youth. A possible explanation is that, although BHCK promoted fruit and vegetable intake at the store, recreation center, and social media/texting levels, fruits and vegetables were not the only promoted food items in the snacks and cooking phases. Furthermore, fruits and vegetables comprise only 1.0% of items purchased by low-income African-American children and adolescents in corner stores, as reported in a previous study conducted in Philadelphia, PA, U.S.<sup>216</sup> However, other multilevel childhood obesity interventions have reported a positive impact on fruit and vegetable intake in youth<sup>169,171,281</sup>, demonstrating that this may be an effective approach to improve youth's diet quality. Nevertheless, future interventions should test different approaches to improve fruit and vegetable intake among low-income African-American youth, perhaps by focusing on the promotion of frozen, canned, and fresh produce, while decreasing consumption barriers such as price, food quality, and convenience. Given that African-American youth have lower dietary quality than other groups in the U.S., it is imperative that future interventions and policies focus on improving healthier food intake in this population.<sup>279</sup>

Even though healthier and unhealthier purchasing increased over time, total daily calorie intake declined from baseline to post-intervention evaluation among both groups. Although BHCK promoted low-sugar beverages and water during the beverage phase, the intervention did not restrict availability of these items in the store and after-school. In

addition, it is possible that youth may have substituted high-fat, high-sugar beverages and snacks with lower-fat, lower-sugar options that were not captured by the BKFFQ, such as low-fat string cheese, low-sugar beverages, fruit cups in 100% juice, etc., which may help explain the decline in calorie intake observed over time. Food and beverage substitutions may also explain the lack of effect in total daily calorie intake. Moreover, although SSB still represents more than 10% of total caloric intake, the percentage of total daily energy from SSB seems to be decreasing since 2000, and has reached a plateau among all youth ages and races in the U.S.<sup>282</sup> Although the Shape Up Somerville intervention successfully decreased unhealthy intake in children (-2.0 ounces of SSB/day), they also did not find an effect of the intervention on children's daily fruit and vegetable intake.<sup>167</sup>

Interestingly, we found that the BHCK intervention increased number of different items per week of both healthier and unhealthier food purchasing among children 9-12 years of age. Our finding suggests that although improving availability and promotion of healthier food was effective both overall and among younger youth, this age group did not decrease the number of different items of unhealthier food items purchased. Research with 10-12 year-old youth in New York found that substitution of healthier for unhealthier food is related to how much money a child has available<sup>283</sup>, suggesting that low-income youth are more likely to change food purchasing patterns if unhealthier food prices are increased. Therefore, pricing strategies could be effective in improving healthier food purchasing in this population. We also noted that the food purchasing score increased substantially in both groups. A possible explanation is that all BHCK corner stores improved their Healthy Food Availability Index (HFAI) score, although the largest change was seen among intervention corner stores (mean change HFAI among

comparison corner store: 1.67 versus intervention: 5.65,  $p=0.01$ ).<sup>275</sup> As BHCK worked with three wholesalers, important food suppliers to all Baltimore corner stores, it is possible that other store owners not receiving the intervention were driven to stock more healthier foods in their stores when exposed to newer healthier food items at the wholesaler-level. Furthermore, the overall increase in number of healthier foods purchased among youth over time may reflect an overall gain in purchase power as youth get older.<sup>216</sup> Another explanation for the positive effect on healthier food purchasing variety (overall and among younger youth) may be the nutrition education sessions conducted with youth in recreation centers and the in-store point-of-purchase promotions with repeated taste tests of the promoted healthier snacks. Lastly, although not statistically significant, older youth increased variety of healthier foods purchased, but the direction of the effect was negative when compared to control older youth. It is possible that other social and household factors influenced youth to purchase less types of either healthier or unhealthier foods than the environmental factors accounted for in the BHCK intervention.

Limitations to this study should be noted. First, this study experienced a higher attrition rate than initially projected (24.9 %), thus decreasing the final sample size, despite efforts to avoid drop-outs (e.g. eligibility criteria included intent to stay within the study areas over the next two years, multiple attempts to contact the families by phone, and using household visits to conduct follow-up surveys). However, when we compared baseline characteristics between individuals with completed follow-up evaluation and missing informants regarding covariates and outcomes, we identified that youth with a female and older caregiver were more likely to remain in the study. Thus, to address

potential selection bias, we included caregiver's age and sex as covariates in all multilevel regression models, and used maximum likelihood methods to produce unbiased estimates for data missing at random. Second, randomization at the individual-level was not possible. Nevertheless, selection bias was also ameliorated by having a comparison group of youth sampled from similar neighborhoods. Given that participating youth were low-income urban African Americans, results may not be generalizable to other populations. Third, due to the nature of the multilevel, multicomponent community-based trial, it was not possible to identify which specific components of the BHCK intervention led to changes in diet and food purchasing behaviors. In addition, although the program was implemented according to our initial process evaluation standards, achieving optimal intensity of the intervention (e.g. form of delivery, duration, and frequency) is challenging<sup>284</sup>, and may partially explain the modest impact on dietary intake. Fourth, BHCK was implemented in two waves at different times (one year apart). Although the structure of the intervention remained the same across the waves, improvements in the design of intervention materials and lessons learned from wave 1 were implemented during wave 2 (e.g.: increased size of posters, implemented 'review phase' to increase duration of the intervention, increased frequency of social media posts from weekly to daily). However, a sensitivity analysis with an additional interaction term to explore potential differences in impact by wave did not show any statistically significant differences between waves. Fifth, although multiple testing is a concern, we explored differences between only two categories of ages based on a priori hypothesis and distinct food-related behaviors previously reported in the literature. Lastly, to minimize respondent burden, we did not gather information on the quality or quantity of



food acquired by the youth when collecting data on food purchased. Furthermore, in our food acquisition survey, we asked youth to only report on food acquisition when they were purchasing food for themselves (without including food that others purchased for them). We did not examine test-retest reliability of the youth food purchasing survey; however, information bias was minimized by the randomized design and the statistical methods employed. Future studies investigating food purchasing patterns in youth should explore changes in frequency, quantity, and amount of money spent on food.

## **Conclusions**

We found that intervening in the community food environment concomitantly with nutrition education in after-school settings may be a promising strategy to drive healthier food purchasing and decrease intake of sweet snacks among low-income, urban, African-American youth. Our findings support the effectiveness of a multilevel, multicomponent nutrition intervention program in improving healthier food purchasing behavior and decreasing caloric intake from less healthful foods, adding to evidence from previous studies. This study provides evidence-based information suggesting that intervening in the environment and improving healthful food access in food deserts can impact food behaviors among youth, which may lead to decreased prevalence of obesity and improved health outcomes. However, it is crucial that changes in healthful food access be supplemented by promotional activities to increase demand.

## 5.6 Tables for Chapter 5

**Table 5.1:** Food purchasing items in the Child Impact Questionnaire and score development

<b>Healthful foods items (n=38)</b>	1% or skim milk, diet soda, water, 100% fruit juice, sugar free drinks, fruit flavored water, unsweetened tea, fresh fruits such as apples, oranges, bananas, frozen and canned fruit, fresh, frozen, and canned vegetables, canned tuna in water, low sugar/high fiber cereals, 100% whole wheat bread, hot cereal, pretzels, baked chips, reduced-fat chips, dried fruit, nuts or seeds, cooking spray, grilled chicken, grilled seafood, fruit and vegetable as side dishes, deli sandwich, tacos, yogurt, granola	<u>Healthier food purchasing variety score (observed)<sup>1</sup></u> Maximum score: 34 Minimum score: 0 Mean: 2.6 Standard deviation: 3.6 Cronbach's alpha: 0.87
<b>Unhealthful foods items (n=28)</b>	whole milk, 2% milk, regular soda or regular energy drinks, fruit drinks, sweetened iced tea, sports drinks, applesauce, sugary cereals, white bread or split top wheat, burger, pizza, fried chicken, fried seafood, fries, fried chicken sandwich, carryout-Chinese food, chips, baked goods (cookies, cakes, poptarts), chocolate candy, ice cream, juice popsicles, snow cones, other candies.	<u>Unhealthier food purchasing variety score (observed)<sup>1</sup></u> Maximum score: 19 Minimum score: 0 Mean: 4.6 Standard deviation: 3.7 Cronbach's alpha: 0.80

<sup>1</sup>For the number of different items per week of food purchasing variable construction, we first assigned one point to each food/beverage item the youth reported purchasing in the past 7 days, or 0 if they did not purchase that item. Then, we summed all the items belonging to "healthier foods" to derive the healthier food purchasing variety variable, and separately summed those under "unhealthier items" to derive the unhealthier food purchasing variety variable. Maximum, minimum, means, and standard deviations are reported based on the baseline number of different items purchased per week observed among children in BHCK.

**Table 5.2:** BHCK low-income urban African-American youth's socio-demographic characteristics at baseline

Baseline Characteristics	n (508)	Intervention (n=272)	Comparison (n=236)	p-value
Youth				
Gender				
Male (%)	226	45.9	42.8	0.45
Female (%)	282	54.1	57.2	
Age (years) - Mean (SD)		11.7 (1.3)	11.9 (1.6)	0.11
9-12 (%)	339	70.7	61.8	0.03 <sup>a</sup>
13-15 (%)	170	29.3	38.1	
Race – African-American (%)	493	95.9	97.5	0.94
BMI (age- and sex-specific category)				
Normal weight (%)	260	48.9	55.3	0.20
Overweight (%)	117	23.9	22.1	
Obese (%)	127	27.2	22.6	
Total caloric intake (kcal) - Mean (SD)	508	1692.5 (915.4)	1777.2 (1107.9)	0.34
Caregiver				
Gender – Female (%)	508	92.3	90.7	0.5
Age (years) – Mean (SD)	506	38.5 (8.9)	40.3 (9.7)	0.02 <sup>a</sup>
Education Level				
< High School (%)	89	19.5	15.3	0.5
High School (%)	204	39.3	41.3	
> High School (%)	214	41.2	43.4	
Household				
Individuals in the household - Mean (SD)	508	4.5 (1.6)	4.6 (1.6)	0.50
Annual Income (US\$)				
0-10,000 (%)	120	25.7	21.2	0.16
10,001-20,000 (%)	116	19.1	27.1	
20,001-30,000 (%)	92	19.1	16.9	
>30,000 (%)	180	36.0	34.7	

**Table 5.2 continues**

**Table 5.2 continued**

Baseline Characteristics	n (508)	Intervention (n=272)	Comparison (n=236)	p-value
Food Assistance Participation				
SNAP (%)	372	75.4	70.7	0.30
WIC (%)	114	22.4	22.4	0.99
Housing Arrangement				
Living w/ family or other (%)	54	8.8	12.7	0.10
Rented (%)	344	68.7	66.5	
Owned (%)	110	22.4	20.7	

Abbreviation: BMI: Body Mass Index; SD: standard deviation; SNAP: Supplemental Nutrition Assistance Program; WIC: The Special Supplemental Nutrition Program for Women, Infants, and Children

<sup>a</sup> Intervention groups are statistically different when comparing the proportion of youth characteristics using the chi-square test or two-tailed t-test.

**Table 5.3:** Adjusted differences in purchasing behaviors between intervention and comparison youth after BHCK intervention <sup>a,b</sup>

Youth Purchasing Behavior	Predictive Baseline		Predictive Post-intervention		Pre-post change: adjusted difference <sup>c</sup>
	Intervention	Comparison	Intervention	Comparison	
	Mean (SE)	Mean (SE)	Mean (SE)	Mean (SE)	Effect (95% CI)
<b>Healthier Food</b>					
Items per week	2.6 (0.9)	3.2 (0.9)	11.4 (0.9)	10.6 (0.9)	<b>1.4</b> <b>(0.05; 2.8)</b>
9-12 years old	2.4 (0.9)	3.4 (0.9)	11.9 (0.9)	10.2 (0.9)	<b>2.8</b> <b>(0.9; 4.6)</b>
13-15 years old	3.5 (1.0)	2.9 (1.0)	9.6 (1.1)	10.3 (1.0)	-1.4 (-3.6; 0.8)
<b>Unhealthier Food</b>					
Items per week	4.6 (0.6)	5.0 (0.6)	10.7 (0.6)	10.1(0.6)	0.9 (-0.2; 2.1)
9-12 years old	4.2 (0.6)	4.7 (0.6)	10.9 (0.6)	9.9 (0.6)	<b>1.6</b> <b>(0.1; 3.0)</b>
13-15 years old	6.0 (0.8)	5.4 (0.7)	9.9 (0.9)	10.0 (0.8)	-0.7 (-2.6; 1.2)

Abbreviations: SE (standard error); CI (confidence interval)

<sup>a</sup> Multilevel models were conducted with Stata 13.1 package with the maximum likelihood option to impute multilevel data (n=509). Multilevel models are good approach to be used under the missing at random assumption, as it models both the means and the random effect jointly <sup>245</sup>.

<sup>b</sup> In all models: treatment group was coded as comparison (0) and intervention (1); time was coded as baseline (0) and post-intervention (1); caregiver's age (continuous), and youth's age (continuous, centered at the mean), caregiver and youth's sex (0=male, 1=female), race (0=African-American, 1= other) were added as covariates; standard errors were corrected for clustering for repeated measures from the same individual and BHCK neighborhood (from 1 to 30).

<sup>c</sup> Mean adjusted difference in change over time for intervention compared to control youth

Healthier food (low fat/low sugar) score by **variety** of different number of food items purchased per week, includes: 1% or skim milk, diet soda, water, 100% fruit juice, sugar free drinks, fruit flavored water, unsweetened tea, fresh fruits such as apples, oranges, bananas, frozen and canned fruit, fresh, frozen, and canned vegetables, canned tuna in water, low sugar/high fiber cereals, 100% whole wheat bread, hot cereal, pretzels, baked chips, reduced-fat chips, dried fruit, nuts or seeds, cooking spray, grilled chicken, grilled seafood, fruit and vegetable as side dishes, deli sandwich, tacos, yogurt, granola.

Unhealthier food (high fat/high sugar) by **variety** of different number of food items purchased per week: regular soda, fruit punch, sweet ice tea, whole milk, tuna in oil, pork hot dog, baked beans, sugar cereal, white bread, sweetened oatmeal, chips, cookies, candy, ice cream, popsicle, butter, oil, mayonnaise.

**Bolded values:**  $p < 0.05$

**Table 5.4:** Adjusted differences in consumption behaviors between intervention and comparison youth after BHCK intervention <sup>a,b</sup>

Youth Daily Consumption	Predictive Baseline		Predictive Post-intervention		Pre-post change: adjusted difference <sup>c</sup>
	Intervention Mean (SE)	Comparison Mean (SE)	Intervention Mean (SE)	Comparison Mean (SE)	Effect (95% CI)
Total daily calorie intake	1706.9 (65.5)	1771.3 (67.8)	1358.1 (73.4)	1349.9 (75.8)	73.6 (-121.6; 268.8)
9-12 years old	1712.1 (76.7)	1669.4 (84.2)	1360.5 (85.7)	1318.2 (92.5)	0.7 (-242.3; 243.8)
13-15 years old	1678.4 (104.3)	1927.7 (96.8)	1377.6 (104.3)	1437.9 (108.4)	186.6 (-137.7; 510.9)
<b>Beverage</b>					
Sugary beverages (total kcal)	147.8 (8.1)	160.3 (8.6)	181.7 (9.6)	170.6 (10.1)	23.4 (-7.3; 54.1)
9-12 years old	125.0 (9.1)	138.7 (10.3)	180.1 (10.7)	168.0 (11.8)	25.8 (-10.1; 61.7)
13-15 years old	182.7 (15.9)	188.6 (15.1)	201.1 (19.4)	196.3 (17.1)	9.8 (-48.1; 67.7)
Fruit Punch (ounces, daily)	4.7 (0.5)	5.5 (0.5)	5.3 (0.4)	5.2 (0.4)	0.8 (-1.0; 2.5)
9-12 years old	3.9 (0.6)	4.5 (0.6)	5.2 (0.5)	4.8 (0.5)	0.9 (-1.2; 3.1)
13-15 years old	5.6 (0.8)	6.4 (0.9)	5.9 (0.9)	6.5 (0.8)	0.1 (-3.1; 3.3)
<b>Snacks</b>					
% of kcal from sweets	14.9 (0.6)	15.2 (0.6)	14.5 (1.9)	15.8 (0.7)	-1.0 (-3.1; 1.2)

**Table 5.4 continues**

Table 5.4 continued

Youth Daily Consumption	Predictive Baseline		Predictive Post-intervention		Pre-post change: adjusted difference <sub>c</sub>
	Intervention Mean (SE)	Comparison Mean (SE)	Intervention Mean (SE)	Comparison Mean (SE)	Effect (95% CI)
9-12 years old	15.5 (0.6)	16.1 (0.7)	14.9 (0.7)	15.5 (0.8)	0.1 (-2.7; 2.8)
13-15 years old	15.1 (0.9)	14.3 (0.8)	14.7 (0.9)	11.9 (1.1)	<b>-3.5 (-7.0; -0.1)</b>
Dietary total sugar (grams)	120.3 (2.2)	117.2 (2.3)	121.1 (2.6)	115.7 (2.7)	2.3 (-6.5; 11.0)
9-12 years old	117.8 (2.5)	113.6 (2.8)	119.4 (2.9)	113.5 (3.2)	1.6 (-8.7; 11.9)
13-15 years old	125.7 (4.1)	124.6 (3.8)	123.3 (5.0)	119.3 (4.4)	2.9 (-13.1; 19.1)
146 Dietary sodium (mg)	2321.6 (28.0)	24702.9(29.6)	2326.0 (33.3)	2415.7 (34.7)	-9.2 (-118.1; 100.1)
9-12 years old	2259.9 (31.5)	2360.5 (36.1)	2281.5 (37.5)	2376.7 (41.3)	4.7 (-128.7; 138.1)
13-15 years old	2446.1 (54.1)	2484.6 (50.9)	2427.9 (65.5)	2497.1 (57.5)	-30.9 (-219.9; 157.9)
Fruit (total cups)	1.7 (0.1)	1.4 (0.1)	1.4 (0.1)	1.2 (0.1)	-0.1 (-0.3; 0.2)
9-12 years old	1.8 (0.1)	1.5 (0.1)	1.3 (0.1)	1.2 (0.1)	-0.1 (-0.5; 0.1)
13-15 years old	1.5 (0.1)	1.5 (0.1)	1.4 (0.1)	1.1 (0.1)	0.2 (-0.1; 0.6)

Table 5.4 continues

**Table 5.4 continued**

Youth Daily Consumption	Predictive Baseline		Predictive Post-intervention		Pre-post change: adjusted difference <sup>c</sup>
	Intervention Mean (SE)	Comparison Mean (SE)	Intervention Mean (SE)	Comparison Mean (SE)	Effect (95% CI)
Vegetable (total cups)	0.9 (0.1)	1.0 (0.1)	0.8 (0.1)	0.9 (0.1)	-0.1 (-0.1; 0.1)
9-12 years old	1.0 (0.1)	1.1 (0.1)	0.8 (0.1)	0.9 (0.1)	-0.1 (-0.2; 0.1)
13-15 years old	0.9 (0.1)	0.9 (0.1)	0.9 (0.1)	0.8 (0.1)	0.1 (-0.2; 0.2)
Fat (servings)	3.1 (0.1)	3.0 (0.1)	3.2 (0.2)	3.2 (0.1)	-0.1 (-0.2; 0.2)
9-12 years old	3.3 (0.1)	3.2 (0.1)	3.2 (0.1)	3.2 (0.1)	-0.1 (-0.5; 0.2)
13-15 years old	3.3 (0.1)	3.2 (0.1)	3.2 (0.1)	3.2 (0.1)	-0.1 (-0.5; 0.2)

Abbreviations: SE (standard error); CI (confidence interval)

<sup>a</sup> Multilevel models were conducted with Stata 13.1 package with the maximum likelihood option to impute multilevel data (n=509). Multilevel models are good approach to be used under the missing at random assumption, as it models both the means and the random effect jointly <sup>245</sup>.

<sup>b</sup> In all models: treatment group was coded as comparison (0) and intervention (1); time was coded as baseline (0) and post-intervention (1); caregiver's age (continuous), and youth's age (continuous, centered at the mean), caregiver and youth's sex (0=male, 1=female), race (0=African-American, 1= other), total daily calorie intake (continuous) were added as covariates; standard errors were corrected for clustering for repeated measures from the same individual and BHCK neighborhood (from 1 to 30).

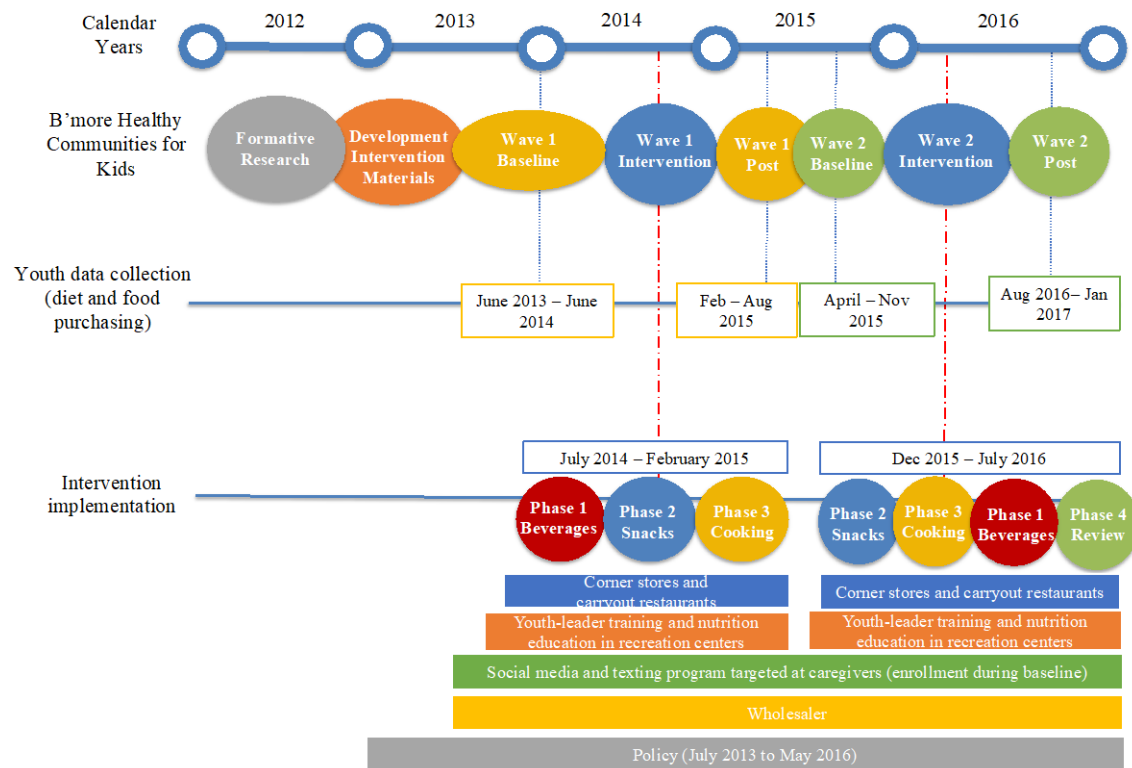
<sup>b</sup> Mean adjusted difference in change over time for intervention compared to control youth

**Bolded** values: p<0.05

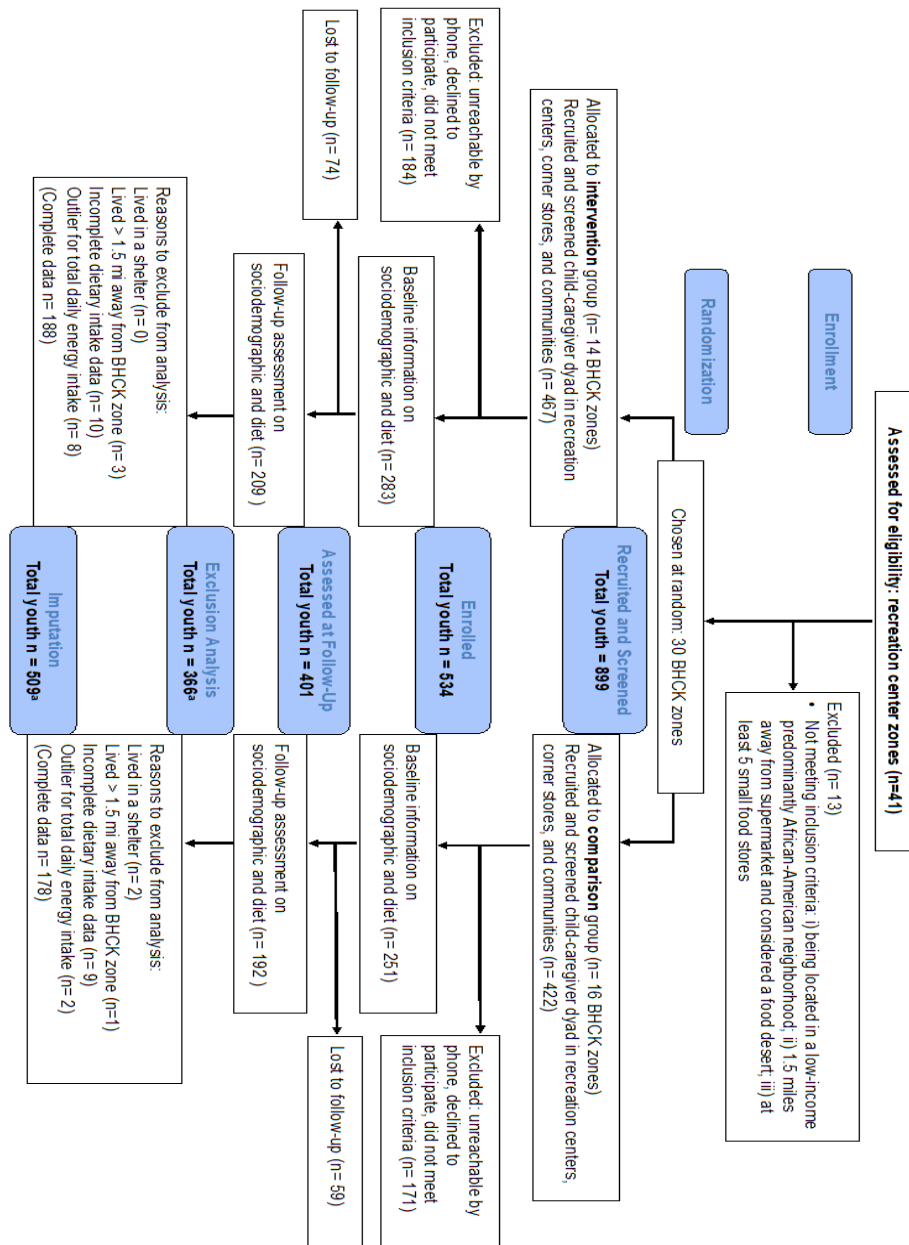


## 5.7 Figures for Chapter 5

**Figure 5.1:** Overview of the timing of B'more Healthy Communities for Kids implementation and data collection



**Figure 5.2:** CONSORT flowchart of the randomization and course of the B'more Healthy Communities for Kids intervention



<sup>a</sup> Analyses accounted for missing data using maximum likelihood methods; final imputed sample size in the multilevel analysis n = 509.

## **Chapter 6. The Impact of a Multilevel Childhood Obesity Prevention Intervention on Healthful Food Acquisition, Preparation, and Fruit and Vegetable Consumption on African American Adult Caregivers**

### ***6.1 Abstract***

**Objectives:** To evaluate the secondary impact of a multilevel, child-focused, obesity intervention on food-related behaviors (acquisition, preparation, and fruit and vegetable (FV) consumption) on youths' primary caregivers.

**Design:** B'more Healthy Communities for Kids (BHCK), group-randomized, controlled trial, promoted access to healthy food and food-related behaviors through wholesaler and small store strategies, peer-mentor led nutrition education aimed at youth, and social media and text messaging targeting their adult caregivers. Measures included caregivers' (n=516) self-reported household food acquisition frequency for FV, snacks, and grocery items over 30 days, and usual consumption of FV in a sub-sample of 226 caregivers via the NCI FV Screener. Hierarchical models assessed average-treatment-effects (ATE). Treatment-on-the-treated-effect (TTE) analyses evaluated the correlation between behavioral change and exposure to BHCK. Exposure scores at post-assessment were based on self-reported viewing of BHCK materials and participating in activities.

**Setting:** 30 Baltimore City low-income neighborhoods

**Subjects:** Adult caregivers of youth ages 9-15 years.

**Results:** 90.89% of caregivers were female, average 39.31 ( $\pm$  9.31) years. Baseline mean fruit intake (servings/day) was 1.30 ( $\pm$  1.69) and vegetable was 1.35 ( $\pm$  1.05). In ATE, no significant effect of the intervention was found on caregiver food-related behaviors. In TTE, for each point increase in the BHCK exposure score (range 0-6.9), caregivers increased daily consumption of fruits by 0.2 servings ( $0.24 \pm 0.11$ ; 95% CI 0.04; 0.47). Caregivers reporting greater exposure to social media tripled their daily fruit intake ( $3.16 \pm 0.92$ ; 95% CI 1.33;4.99) and increased frequency of unhealthy food purchasing, compared to baseline.

**Conclusions:** Child-focused community-based nutrition interventions may also benefit family members' fruit intake. Child-focused interventions should involve adult caregivers and intervention effects on family members should be assessed. Future multilevel studies should consider using social media to improve reach and engage caregiver participants.

**Keywords:** Fruit and vegetable, adult health, environmental intervention, African American, food purchasing, childhood obesity

## **6.2 Introduction**

Dietary consumption leading to an energy imbalance is among the most proximal drivers of obesity.<sup>18</sup> Diets today, especially in low-income, urban communities of color, are often characterized by high intake of refined carbohydrates, added sugars, fats, and salt due to high consumption of energy dense, processed foods.<sup>285,286</sup> Analyses of nationally representative surveys have demonstrated increased intake of high energy-dense foods, such as sugar-sweetened beverages<sup>72</sup> and snacks<sup>73</sup>, in the past three decades among U.S. adults. Despite recent findings showing a temporal improvement in dietary quality from 1999-2012 among the overall adult population<sup>287</sup>, African Americans and Hispanic adult populations continue to have the lowest dietary quality in the country.<sup>76</sup> These disparities in diet quality are likely influenced by racial and ethnic residential segregations and inequalities in availability, access, and affordability of nutrient-dense foods and resources.<sup>46</sup>

In view of the multifactorial etiology of weight gain, efforts that simultaneously address multiple levels of the food system are recommended.<sup>8</sup> One example of such efforts are multilevel multicomponent community-based interventions, in which different levels of influence are targeted to change the food environment surrounding the individual, and to promote behavioral change.<sup>8</sup> Despite recognizing the importance of these various levels of influence outlined in socio ecological models (i.e., individual, household, organizational, community, policy)<sup>288</sup>, most multilevel childhood obesity prevention interventions have primarily delivered nutrition education in school settings, yielding mixed results<sup>152,289</sup>, with limited activities to modify the out of school environment and for engaging families.<sup>5</sup> Furthermore, insufficient evaluation of the

impact of multilevel community-based childhood obesity prevention trials on diet and food behaviors in children and their caregivers exists.<sup>271</sup>

Childhood obesity prevention interventions that also engaged adult caregivers have shown more positive child-related outcomes than child-only interventions.<sup>93,94</sup> However, few child-focused interventions have reported impacts on caregiver behavioral outcomes<sup>195</sup>, due to limited assessment of nutrition behaviors among this group.<sup>196</sup> Understanding the impact of childhood obesity prevention on caregivers is important because families' eating practices, rules, and support influence children to initiate and sustain positive dietary changes, while providing opportunities for social learning.<sup>197</sup> Therefore, we evaluated the secondary impact of a child-focused community intervention on youths' adult caregivers food acquisition, preparation, and fruit and vegetables (FV) consumption.

B'more Healthy Communities for Kids (BHCK) was a community-based multilevel multicomponent childhood obesity prevention intervention that sought to modify the food environment outside of school for low-income 9-15 years old youth in Baltimore, U.S.<sup>290</sup> We hypothesized that caregivers would have improved food-related behaviors in part due to the environmental changes of the BHCK intervention and educational activities through social media and texting. For instance, BHCK improved availability and promotion of healthful foods and beverages in small food stores (i.e., corner stores/carryout restaurants) that were frequented by youth outside of school hours and located in the neighborhoods where BHCK families lived.<sup>291</sup> Caregivers may also have been exposed to or attended community nutrition education sessions given that program activities in intervention neighborhoods were public and available to all

community members.<sup>292</sup> In addition, caregivers could have also been exposed to communication materials (i.e., flyers, giveaways) that were brought home by youth attending BHCK activities in the after-school nutrition education sessions for youth. Lastly, BHCK social media and text-message intervention components targeted adult caregivers, in which its content aimed to reinforce health-related messages utilized at other BHCK intervention components.

Multilevel multicomponent interventions are implemented as synergistic interventions with components reinforcing one another at different levels<sup>293</sup>; however, this limits the researcher's ability to identify which specific component was more successful in influencing behavior change. Another consideration for multilevel multicomponent community-based interventions is regarding the extent to which program components are implemented with sufficient intensity.<sup>294</sup> One approach to identifying the intervention component that led to behavior change in multilevel multicomponent interventions, is to conduct treatment-on-the-treated effect (TTE) as a secondary impact analysis, in which study participants are analyzed according to the treatment received, instead of the original treatment assigned (average treatment effects - ATE).<sup>292</sup> Although causality cannot be inferred, this analysis may provide information about the dose response relationship between level of exposure to the intervention and behavioral change, and may identify specific intervention components that are more likely to influence the outcomes.<sup>193</sup>

Therefore, this manuscript aimed to answer the following questions:

1. What was the impact of the multilevel BHCK intervention on food-related behaviors (purchasing of healthier and unhealthier food items, food

preparation and consumption of fruits and vegetables) among adult caregivers?

2. Was change in food-related behaviors associated with caregiver's exposure level ('dose received') to the BHCK intervention?
3. What component of the multilevel BHCK intervention was correlated with changes in food-related behaviors among caregivers?

## **6.3 Methods**

### **6.3.1 Study design**

BHCK employed a group randomized controlled trial design with two intervention arms (random allocation to treatment on a 1:1 basis), implemented in two rounds (waves). A detailed description of the formative research, trial design, and sample size calculation has been published elsewhere.<sup>290</sup>

The intervention integrated different levels of an ecological model and multiple intervention components into a food systems approach from wholesalers, to small food stores, and to families that promoted access to nutritious food and balanced. Using a socio-ecological model for health promotion, the BHCK intervention tapped into the dynamic interplay among individual, behavior, household, environment, and policy levels.<sup>288</sup> Individual-level components were based in community recreation centers, using youth-leaders (college and high-school trained mentors) to provide education and nutrition skills to youth (9-15 years old), and through social media and text messaging to caregivers. The family-level included social media and texting. Social media (Facebook and Instagram) were used to integrate the different levels of BHCK to inform family-



level nutrition behaviors. Recipes, news, and BHCK-specific activities were featured in these communication channels. Text messages (sent 3 times/week) and social media platforms also targeted mainly youth's caregivers by guiding them to set and achieve goals to healthier behaviors for themselves and their families, as well as promoting BHCK community activities. An example of a goal setting text message was as follows: *"Does your child have a sweet tooth? Try offering them granola bars or fruit as an alternative to candy 1 time this week."* Intervention flyers and promotion of the intervention were mailed to caregivers and youth twice a month at the end of wave 2 only. An overview of the intervention is presented in **Table 6.1**.

The BHCK intervention promoted healthful foods/beverages and behaviors in three sequential phases, each lasting two months: 1) healthier beverages (i.e., lower-sugar fruit drinks (25-75% less sugar than the original version), sugar-free drink mixes, zero-calorie flavored water, diet or low-sugar soda, and water), 2) healthier snacks (i.e., low-fat yogurt, low-fat popcorn, fresh fruits, fresh vegetables, low-sugar granola bars, and mixed fruits in 100% fruit juice), and 3) healthier cooking methods (i.e., cooking ingredients, such as low-sugar cereals, low-fat milk, 100% whole wheat bread, fresh/canned/frozen vegetables). A fourth phase, intended to review main messages covered in the previous phases, was implemented in wave 2 only.

### **6.3.2 Setting**

The trial took place in 30 low-income, predominantly African-American neighborhood zones in Baltimore, with low access to healthy food. Zones were defined as a 1.5-mile area around a recreation center (nucleus). Eligibility criteria for BHCK zones were: 1)

predominantly African-American (>50%); 2) low-income (>20% of residents living below the poverty line); 3)  $\geq 5$  small (<3 aisles, no seating) food sources (e.g., corner stores and carryout restaurants); 4) having a recreation center more than ½ mile away from a supermarket.<sup>97</sup> The 30 zones were randomized into intervention (n=14) and comparison (n=16) groups, with recreation centers as the main unit of randomization. wave 1 was implemented from July 2014-February 2015 (n=7 intervention and 7 comparison zones), and wave 2 from December 2015-July 2016 (n=7 intervention and 9 comparison zones).

### ***6.3.3 Subjects***

After randomly selecting BHCK zones, a sample of adult caregivers and their children were recruited in the recreation centers and around the stores within the 1.5-mile buffer zone. Eligibility for the adult caregiver and child participants were determined at the household level. Household eligibility criteria were as follows: (1) being a caregiver (>18 years old) of at least one child aged 9-15 years; (2) living in the same location for at least one month; and (3) not anticipating a move in the next two years. A child's main caregiver was screened for household eligibility prior to obtaining parental consent and being interviewed. Child and caregivers received \$30 and \$20 gift cards, respectively, after each of the pre- and post-intervention interviews.

#### **6.3.4 Training of interventionists and data collectors**

BHCK-interventionists were graduate students, public health educators, dietitians, or youth-leaders trained in nutrition and health education, and were not masked to the group (zone) assignment. Data collectors were graduate students and staff who were intensively trained, including through role plays and observations. They were masked after assignment to intervention to reduce information bias. Following the interviews, data were checked for errors by the interviewer and a second research analyst. The data manager ensured that questionnaires had no missing pages or implausible values.

#### **6.3.5 Measures**

##### *Caregiver data collection*

Baseline data were collected from June 2013 to June 2014 (wave 1) in a total of 298 adult caregivers, and from April to November 2015 (wave 2) in 235 caregivers. A post-evaluation was conducted from March 2015 to March 2016 (wave 1) and from August 2016 to January 2017 (wave 2), taking place immediately after implementation of the intervention to one year (wave 1) or up to six months (wave 2). We did not analyze participants who reported living in unstable housing arrangements such as in shelters or transitional housing (n=2), lived more than 1.5 miles away from a BHCK recreation center (n=5), had incomplete dietary intake data (n=14), or were considered an outlier (>10 servings/day, or >99.5<sup>th</sup> percentile) for fruit and vegetable intake (n=7), yielding a total of 373 participants with complete baseline and follow-up information for the analytical sample (**Figure 6.1**).

### *Fruit and vegetable consumption*

The National Cancer Institute (NCI) FV screener was used to collect usual consumption of 10 categories of FV intake in adult caregivers over the past month. It is a short dietary assessment instrument consisting of 14 questions and is a modified version of the FV screener from the Eating at America's Table Study.<sup>236</sup> The screener inquired about frequency of intake of fruit, 100% fruit juice, and vegetables (lettuce, greens, potatoes, and legumes) consumed in a monthly, weekly, or daily basis. The amount of each food item was estimated as cups or servings and self-reported by the participant. We calculated the total number of both fruit and vegetable servings consumed daily using the 2005 MyPyramid definition of cup equivalents. For each food group, we multiplied the average frequency (daily) by the cup equivalent. The instrument has been validated and presents high correlations with 24-hour dietary recall, and is less burdensome compared to other instruments.<sup>237</sup> Food models were used to improve accuracy of serving size information. The NCI FV Screener was added to the data collection protocol after the wave 1 intervention had begun and was first administered during wave 1 post-intervention. Therefore, the effect of the intervention on FV intake of adults was calculated only using BHCK wave 2 sample with pre- and post-evaluation data (n=196), as this instrument was not used during wave 1 baseline data collection.

### *Household food preparation*

Adult caregivers reported their frequency of meal preparation (cooking methods) for the household in the previous 30 days from the interview.<sup>241</sup> In addition, respondents ranked the top three most common cooking methods used when they prepared chicken, turkey

(including ground turkey and turkey bacon), pork (including bacon), ground beef, fish, eggs, greens (excluding lettuce), and potatoes. The survey was adapted from an instrument used in a similar study<sup>241</sup>, and on the basis of formative research.<sup>295</sup>

We created a healthful cooking score using similar methods previously reported in the literature.<sup>7</sup> Cooking methods were assigned values based on the amount of fat used, as follows: deep fry or pan-fried with oil (-2); pan-fried, drained or use of cooking spray (-1); not prepared in the last 30 days (0); pan-fried, drained, and rinsed with hot water (+1); broiled/baked, or grilled, or steamed, or boiled, or raw, or microwaved (+2). The scores were separately calculated for each food, weighted according to the most commonly reported method to estimate the healthiness of the cooking preparation: 60% (first method most commonly used), 30% (second method), and 10% (third method). For example, if chicken was most commonly pan-fried, second most commonly grilled, and third most commonly cooked with cooking spray, the score was calculated as  $(0.60 \times -2) + (0.30 \times 2) + (0.1 \times -1)$  as an indicator of the overall healthiness of chicken preparation. Then, the scores for all of 8 foods were summed to obtain the overall household food preparation score (mean: -0.07 (0.88), range -1 to 2.1).

#### *Frequency of food acquisition*

Caregivers reported the number of times they acquired food from different food sources in the previous 30 days from the interview date (e.g., “How many times did you get these foods?”). Food acquisition included all of the following: food/beverages that were purchased with cash (i.e., no food assistance program), purchased with food safety net

program benefits (SNAP, WIC), and food that was obtained for free (i.e., from pantries or donated by family/friends).<sup>240</sup>

A list of 33 BHCK-promoted healthier foods and beverages and 21 less healthful foods and beverages was provided, and respondents reported the number of times they had acquired each food in the specified timeframe. Prepared foods acquired from delis, vendors, or restaurants were not included, as this instrument was designed to measure foods purchased for consumption in the home environment rather than for immediate consumptions. The list was designed on the basis of formative research conducted with the community<sup>241</sup>, and reflected foods promoted during the BHCK intervention. Face and content validity of the questionnaire were assessed on 15 randomly selected adult caregivers during the pilot phase.<sup>241</sup> The healthful and less healthful food acquisition variables were additive items based on the acquisition frequency of 33 healthful and 21 less healthful foods for each respondent and divided by 30 to yield a daily frequency score, respectively. Additive daily healthful food acquisition frequency ranged from 0.6 to 4.8 with a mean of 0.9 (SD = 0.6), and less healthful food acquisition frequency from 0.1 to 10.2 with a mean of 1.3 (SD = 1.1).

### *Exposure score*

The key variables for assessing exposure ('dose received') were obtained using the 29-item Intervention Exposure Questionnaire (IEQ) collected as part of the post-intervention assessment for intervention and comparison groups. The IEQ measured participant's self-reported viewing of BHCK communication materials (posters, handouts, giveaway), participation in food environment intervention activities (i.e., taste tests, seeing

educational displays, redesigned carryout restaurants' menu, and store promotional shelf-labels), and enrollment in social media/viewing of media posts, and receiving the text messaging program.<sup>292</sup> In addition, eight red herring questions were used to address response bias, and included materials used in previous studies conducted at other sites. We classified individuals into tertiles of red herring responses, where selecting 0-2 red herring answers was considered truthful, 3-5 moderate, 6-8 untruthful responses and kept only individuals in the tertile with the least number of red herring responses. No respondent answered positively to >3 (1/3 or more) of the red herring questions; thus, none of the caregivers with complete responses were excluded from the analysis.

We calculated exposure scores for each component of the BHCK intervention to which adults could be exposed (communication materials, food environment intervention, social media, and texting) and an overall BHCK exposure score. Detailed description of the formation of the exposure score formation is presented in **Table 6.2** and published elsewhere.<sup>292</sup> For each intervention component, points were assigned for exposure to study materials/activities and then scaled into proportions (0-1 range), yielding an *overall BHCK exposure score* of 11 points (possible highest score). A total of 370 adult caregivers had complete exposure data information.

### *Covariates*

Caregivers were assessed on: demographics and household socioeconomic information (age, sex, caregiver education level (categorized into < high school, completed high school, and > high school), employment status, and household income (US\$0-10,000, 10,001-20,000, 20,001-30,000 or higher), housing arrangement (owned, rent, and shared

with family or other arrangement (group housing, transitional housing), and household participation in food assistance programs. These programs included receiving the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) or Supplemental Nutrition Assistance Program (SNAP) benefits in the past year. Caregivers also had their anthropometric measures taken (height using a stadiometer and weight using a portable scale) after removing shoes and heavy clothing. Body mass index (BMI) was calculated as weight (kg) divided by height squared ( $m^2$ ).

### **6.3.6 Data analysis**

All analyses were conducted using Stata 13.1 (College Station, TX). Descriptive statistics were performed to characterize the study sample at baseline by study group assignment. Continuous variables were tested for differences between intervention and comparison groups with independent two-tailed t-tests. The Chi-square test for proportions was used for categorical variables. Variable and model residual distributions were examined for normality and extreme values (outliers) using quantile-quantile plots and goodness of fit tests (Kolmogorov-Smirnov).

The average treatment effects (ATE) on the change in diet, food preparation, and food-acquisition behaviors among adult caregivers were assessed by the difference between the mean change of the outcome in the intervention group compared to the control group. We tested the intervention effect on adult caregivers' food-related behaviors using a multilevel linear mixed-effect model fit by maximum likelihood. Random effects accounted for variation at the BHCK zone and at the caregiver-level (repeated measures).



Due to the 24.9% attrition rate, we used inverse probability weighting (IPW) to address potential bias due to loss to follow-up and to correct for the effects of missing data.<sup>245</sup> Using all available data, we estimated weights for every missing outcome of interest fitting a logistic regression model. We treated the categorical indicator of response at follow-up as the outcome variable, regressed on the baseline response for intake, preparation, or acquisition, with age, sex, income, wave (predictive of dropout) as covariates. Once the weights were determined, they were incorporated in the multilevel linear mixed-effect analysis using the *pweight* option for the *mixed* command in Stata. Results of the ATE analysis using only completed-cases without the IPW method are shown in **Table S6. 1**.

We also conducted a treatment-on-the-treated effect (TTE) analysis, in which study participants were analyzed according to the treatment received,<sup>193</sup> as estimated by their exposure scores. We conducted multiple linear regression models to analyze the association between the change in caregivers' food behaviors (intake, preparation, and acquisition) and caregiver exposure levels (total exposure score, and by exposure to intervention components), adjusted for age, sex, income, and household size. We used a bootstrap method with 2000 repetitions and bias-corrected confidence intervals to account for the within-individual correlation of the data, clustered on the BHCK zone.<sup>247,248</sup> For the significant results, we estimated the proportion of variability explained (effect size) with omega-squared ( $\omega^2$ ) after fitting the multivariate models. A sensitivity analysis using multiple logistic regression on the correlation between the categorical change in food-related behavior (no change versus positive change) and the exposure scores (low (if 0) versus high (if above 0)) was also conducted to estimate the

standardized effect size given by the odds ratio. Given the time frame for follow-up data collection differed by wave, we conducted tests of homogeneity to explore if the effect of exposure was moderated by the two BHCK waves.

For all analyses, we reported the 95% confidence intervals (CI). Statistical significance was defined by a p-value of  $< 0.05$ .

## 6.4 Results

Implementation of each component of the BHCK intervention was evaluated through detailed process evaluation reported elsewhere.<sup>224-226,230,299</sup> **Table 6.1** illustrates implementation quality of each BHCK component. The intervention was implemented with overall moderate- to high-reach, dose delivered, and fidelity.<sup>300</sup>

On average, caregivers presented an *overall BHCK exposure* score of 1.38 points,  $SD \pm 1.2$  (range: 0-6.9), *BHCK Communication Materials* exposure score (mean: 0.6 (observed range: 0.0 - 3.1), possible highest score: 4), *Food Environment* exposure score (mean: 0.3 (observed range: 0.0-3.1), possible highest score: 5), *Social Media* exposure score (mean: 0.2 (observed range: 0.0-2), possible highest score: 2); and a *Text Messaging* exposure score based on the frequency of BHCK text messages received per week (mean: 1.10 (observed range: 0-3).

When comparing the overall exposure scores between the groups, caregivers in the intervention group demonstrated significantly higher mean exposure scores than adult caregivers in the comparison group (intervention: mean  $1.90 \pm 0.08$ ; comparison: mean  $0.82 \pm 0.07$ ,  $p < 0.001$ ) (**Table 6.2**). Even though the comparison group was exposed to the BHCK intervention components, the intervention group had significantly higher exposure scores than the comparison group for the communication materials, food environment,

and text message components ( $p<0.001$ ). Social media exposure scores were not statistically significantly different when comparing group means ( $p=0.06$ ). Reported exposure level to the BHCK intervention was low among caregivers.

#### *Characteristics of the baseline BHCK evaluation sample*

The vast majority of our study sample self-identified as African-American (96.6%), and 49% of caregivers were either overweight or obese (**Table 6.3**). Most caregivers were female (93.2%) and from a household that received SNAP (70.8%). Significant differences were found between treatment groups with respect to caregiver's age ( $p=0.01$ ), being higher in the comparison group.

#### *Impact of BHCK intervention on food-related behavior of caregivers*

In the ATE analysis, we did not find a significant effect of the intervention on the food acquisition, home food preparation, and daily consumption of FV among intervention adult caregivers compared to their counterparts (**Table 6.4**).

#### *Correlates between food-related behaviors and exposure to the BHCK intervention*

The results of the TTE analysis are presented on **Table 6.5** (overall exposure score) and **Table 6.6** (BHCK components exposure score). For each one-point increase in exposure score, there was a 0.24 increase in mean daily fruit serving intake over time ( $0.24 \pm 0.11$ ; 95% CI 0.04; 0.47). There was no statistical difference in the effect of exposure moderated by the two BHCK waves (**Table S6. 2**).

When exploring the exposure score by intervention component, we found a positive change in food-related behaviors among adult caregivers correlated with a greater exposure to the BHCK social media component. For each one-point increase in social media exposure score (e.g., following an additional social media account or seeing an additional post online), there was an increased three servings of daily fruit intake ( $3.16 \pm 0.92$ ; 95% CI 1.33; 4.99) and daily FV intake ( $2.94 \pm 1.01$ ; 95% CI 0.96; 4.93). A higher social media exposure score was also associated with increased unhealthful daily food acquisition score ( $0.47 \pm 0.23$ ; 95% CI 0.02; 0.93). Effect sizes estimated by omega-squared showed a higher proportion of the variance in fruit intake explained by the variance in the social media exposure score ( $\omega^2=0.04$ ), than the effect size of unhealthful food acquisition ( $\omega^2=0.0005$ ) (**Table S6. 2 and Table S6. 3**). Our sensitivity analysis conducted with multivariate logistic regression models showed that the direction of association and the estimated effect sizes given by standardized odds ratios were similar as the linear regression models (**Table S6. 3**).

## **6.5 Discussion**

BHCK tested a 6- to 8-month community-based intervention designed for low-income African-American families to improve access and consumption of healthful foods. The ATE analysis did not show evidence of significant improvement in food acquisition, preparation, and FV consumption among adult caregivers. However, the TTE analysis ('dose received') showed a statistically significant increase in daily intake of fruits among participants who reported higher exposure to the intervention. In addition, we used the exposure score to partition out the change in food-related behaviors influenced by different BHCK intervention components and found that the social media component

had a positive correlation with improved daily fruit intake, daily FV intake, and unexpectedly with higher frequency of unhealthful food acquisition.

Mixed results have been observed among the few childhood obesity interventions that assessed behavioral change at the caregiver-level, mainly due to differences in level of caregiver participation in the intervention, varied quality of outcome measurements, and quality of intervention implementation. The *Screen-Time Weight-loss Intervention* delivered face-to-face in households by community workers to youth (9-12 years old) and their caregivers, did not find an impact on BMI nor physical activity levels of primary caregivers.<sup>301</sup> Authors attributed the null effects due to low adherence to the fidelity of the initial implementation protocol.<sup>301,302</sup> The multilevel multicomponent community-based *Switch what you Do, View, and Chew* intervention that targeted children 9-11 years old attending 10 schools in Minnesota and Iowa, U.S., found a significant increase in intake of self-reported FV weekly servings among intervention caregivers.<sup>171</sup> The *Shape Up Somerville* community-based participatory research study reported decreases in BMI among intervention caregivers; however, height and weight were self-reported, and no behavioral outcome was assessed.<sup>195</sup>

The null impact of BHCK on caregiver's behavior may be attributed to 1) the low intervention exposure experienced by caregivers; and/or 2) the contamination of the intervention activities among comparison caregivers, thus attenuating the average effect towards the null in the ATE analysis.<sup>303</sup> Other community-based interventions have also attributed limited effects resulting from an ATE approach to the low level of engagement informed by TTE analysis. The *Switch* intervention observed greater change in FV weekly intake among caregivers who were more involved in the intervention, compared

to those who were less involved.<sup>171</sup> Another community-based childhood obesity prevention intervention - *The Healthy Families Study* – found positive health-related outcomes among families with higher exposure to the intervention (TTE), and null results with ATE analysis.<sup>303</sup> Authors attributed the null effects from the primary impact analysis to low participation in community classes.<sup>303</sup>

In our study, low exposure might be explained by the fact that the BHCK study sample were not required to attend community-based activities (i.e., taste tests, point-of-purchase promotions, and nutrition education sessions in corner stores, carryout restaurants and recreation centers). Furthermore, we did not expect the intervention study sample to receive the same dose of the program across all components. Conversely, only adult caregivers in the intervention arm were asked to join the text messaging program at study enrollment and were given directions of how to follow BHCK social media platforms. However, both social media platforms were public, meaning that any individual could follow the social media accounts (Facebook and Instagram), which increased the likelihood of exposure contamination among participants in the control group, and that may have attenuated differences between study arms. On the other hand, the usage of a tailored approach may help explain behavior changes observed among only those with higher levels of exposure to the social media component. The social media and text messaging component employed goal-setting bi-directional communication strategies. Social media pages were public accounts with daily posts that mirrored the content of text messaging and other BHCK components, and participants were encouraged to share online achievement, barriers, tips, and resources. The higher reach

and intensity of the social media component may help explain the positive correlation with food-related behaviors, compared to the other intervention components.

The increase in fruit intake was driven by a one-point increase in social media exposure, which corresponds to following at least one of the study social media accounts or seeing four or more posts. Similar to our findings, *The Food Hero* study - a social media campaign targeted at SNAP-eligible families with children - found increased positive beliefs about FV among participants.<sup>304</sup> Although previous studies have tested social media approaches for behavioral interventions<sup>305-308</sup>, to our knowledge, BHCK was the first study to combine these strategies into a multilevel multicomponent community-based nutrition intervention. The use of social media to provide a platform for actionable information and social support for families with children has been recommended in the obesity prevention literature<sup>308-310</sup> and is being further tested in ongoing community-based trials.<sup>311,312</sup>

Given the low consumption of FV among the U.S. population<sup>77</sup>, especially among low-income African-American individuals<sup>78,79</sup>, it is necessary to explore innovative strategies to promote healthier dietary intake. Although we found a positive correlation between self-reported exposure to the BHCK social media component with FV, the main increase in intake was in fruits, and not vegetables. Fruits are sweeter, often do not require any preparation (consumed raw), and generally consumed and accepted as a snack, drink, and dessert<sup>313</sup>, whereas vegetables often require cooking, and are more typically consumed as part of meals.<sup>314</sup> Future studies should consider the impact of the intervention on fruit and vegetables as separate and different food types.<sup>315,316</sup>

Unexpectedly, we found that an increased frequency of unhealthful food acquisition was correlated with greater exposure to the BHCK social media component. One potential reason for this may be that adults exposed to BHCK social media may have also been exposed to online advertising for energy-dense, nutrient-poor foods and mobile marketing food campaigns.<sup>317,318</sup> Prior studies have demonstrated a negative effect of online food advertisement on youth's consumption of healthful foods<sup>319,320</sup>, and similar trends were found for adult caregivers.<sup>321,322</sup> More research needs to be conducted to examine the relationship between public health social media campaigns and advertising exposure.

Limitations of this study should be noted. The survey was administered to self-identified caregivers, under the assumption that they acquire most of the food and cook for their family members. However, some caregivers may not be the primary food purchasers in their households. Also, our measure of frequency of food purchased did not take into consideration the quality or quantity of the acquired food/beverage. Future child-focused interventions should conduct more comprehensive food and nutrient assessments of adult caregivers. The loss of observations over the course of the study is also a limitation, despite our efforts to avoid drop-outs during the course of the study (e.g., eligibility criteria included intent to stay within the study areas over the next two years, multiple attempts were made to contact the families over the phone - and if not possible to reach over the phone, household visits were done to conduct follow-up surveys). Thus, to address potential selection bias, inverse probability weighting (IPW) was employed in the analysis to correct for the effects of missing data.<sup>245</sup> Another study limitation might be the risk of social desirability bias by treatment assignment, reflected



in the self-reported intervention exposure questionnaire. However, our questionnaire included red-herring questions to improve validity, and data collectors were masked to intervention treatment assignment. We were not able to directly assess individual's social media participation, as individuals often display nicknames instead of names used on their profile pages, which precluded our efforts to cross check the self-reported information. In addition, although we utilized a computer software to manage our text messaging program, some people may have not received the texts (because of low credit balance on their phone) or may have not read the text sent.

BHCK was an intervention that sought to modify the out of school community food environment and engage families through social media, but did not implement a component to improve the household food environment. Therefore, future studies aiming at preventing childhood obesity among underserved communities should consider intervening in both community and household food environments. Lastly, although multilevel, multicomponent interventions have broader reach than single-level approaches, they have the additional challenge of achieving low exposure.<sup>284</sup> Hence, conducting a detailed process evaluation during implementation is essential for understanding to what extent the target population is receiving the program.

## **Conclusions**

The BHCK intervention is one of the few child-focused obesity prevention interventions to measure treatment effects at the caregiver-level in terms of food acquisition, preparation, and FV consumption, and the first study to attempt to evaluate a dose response relationship in terms of exposure level to the different intervention components.

Although our ATE analysis including all trial participants demonstrated no effect of BHCK on food-related behaviors, we were able to demonstrate that a higher level of exposure to the BHCK intervention was associated with improvements in daily fruit intake among adult caregivers, particularly among those with higher exposures to the social media component. Our study highlights the importance of optimal dose and intensity of community-based intervention activities to achieve intended behavioral changes, and the possibility of intervention contamination between intervention and comparison participants in community-based behavior interventions. Future multilevel multicomponent community-based interventions should engage caregivers more in the intervention, enroll larger samples, as well as assess engagement and exposure to intervention activities during the trial to enhance likelihood of intervention effectiveness. Social media (Facebook, Instagram) may be a promising tool to improve reach and engage caregiver participants in multilevel childhood obesity interventions.

## 6.6 Tables for Chapter 6

**Table 6.1:** Description of the B'more Healthy Communities for Kids intervention as implemented

BHCK Components	Goal	Materials	Delivery	Duration	Implementation <sup>a</sup>
Wholesaler <sup>225</sup> (n=3)	Ensure stocking of BHCK-promoted food items	<ul style="list-style-type: none"> <li>- In-store signage (shelf-labels) of promoted items</li> <li>- Provision of \$50 gift cards from wholesalers to BHCK intervention stores</li> <li>- Wholesaler circulars with BHCK logo highlighting promoted foods</li> </ul>	1x/month in-person visit by a BHCK-interventionist to maintain shelf-labels position, and monitor availability of promoted items	<p><u>Wave 1:</u> July 2014 to Feb 2015</p> <p><u>Wave 2:</u> Dec 2015 to July 2016</p> <p>Total # visits/wholesaler/wave: 6</p> <p>Length of visits to wholesalers: 1-4hs</p>	<p><u>Reach:</u> high</p> <p><u>Dose delivered:</u> high</p> <p><u>Fidelity:</u> high</p>
Small corner stores <sup>225</sup> and carryout restaurants <sup>226</sup> (n=50)	Improve supply and demand for healthier options of foods/beverages in low-income areas	<ul style="list-style-type: none"> <li>- Gift cards from wholesalers for initial stocking</li> <li>- Stocking sheet with promoted items/ intervention phase</li> <li>- Online training modules for store owners</li> <li>- Store supplies as a reward for watching training modules</li> </ul>	BHCK-interventionists conducted in-store taste testing, put up communication materials, maintained shelf-label position, and monitored availability of promoted items	<p><u>Wave 1:</u> July 2014 to Feb 2015</p> <p>Total # sessions/store: 12</p> <p><u>Wave 2:</u> Dec 2015 to July 2016</p> <p>Total # sessions/store: 15</p> <p>In-store educational sessions were implemented every</p>	<p><u>Reach:</u> medium</p> <p><u>Dose delivered:</u> medium</p> <p><u>Fidelity:</u> medium-high</p>

		(ranging from produce baskets to refrigerators) - Point-of-purchasing promotions and giveaways to customers - Poster and handouts promoting BHCK items - In-store taste tests		other week in each intervention store  Length of in-store promotion sessions: 2h	
Youth-led (n=18) nutrition education in recreation centers <sup>230</sup> (n=14)	Hands-on nutrition education activities delivered by youth-leaders (college and high school students) to children in the 9-15-year range attending the after-school program at the time of the intervention.	- BHCK youth-leaders were trained by BHCK-interventionist (35h) - Nutrition sessions followed the themes of each BHCK phase: 1) healthful beverages, 2) healthful snacks, and 3) healthful cooking methods - Giveaways and taste-tests with children at the end of each session - Posters put up in centers - Handouts distributed to children	Trained youth-leaders were involved in the delivery of the intervention based on the perspectives of Social Cognitive Theory, to encourage mentees to model mentors' health behavior.  Average of 2 youth-leaders/session/center  2 BHCK-interventionists oversaw execution of sessions to monitor intervention	<u>Wave 1:</u> July 2014 to Feb 2015 Total # sessions/center: 14  <u>Wave 2:</u> Dec 2015 to July 2016 Total # sessions/center: 14  Nutrition sessions were implemented every other week by youth leaders  Session length: 1h	<u>Reach:</u> medium  <u>Dose delivered:</u> medium  <u>Fidelity:</u> high
Social media and texting <sup>299</sup>	Integrate all components of intervention and promoted	- Two social media platforms (Facebook & Instagram) featured recipes, news, and	Social medias posts were delivered daily	<u>Social Media:</u> Wave 1 and 2: June 2014 to Jan 2017	<u>Reach:</u> high  <u>Dose delivered:</u> high

	nutrition knowledge, goal setting, and BHCK activities to adult caregivers	<p>BHCK-specific activities related to promoted items and behaviors</p> <p>- Adult caregivers enrolled in the BHCK study (intervention group only) received a text message related to healthier eating behavior</p> <p>- Intervention households received weekly mailings with intervention flyers and promotional materials</p>	<p>BHCK-interventionists monitored posts daily</p> <p>Bi-directional text messages were sent 3-5 times a week</p> <p>BHCK-interventionists sent weekly mailings, alternating child- and caregiver-targeted contents.</p>	<p><u>Text message:</u> Wave 1: July 2014 to Feb 2015</p> <p>Wave 2: Dec 2015 to July 2016</p> <p><u>Mailing:</u> Wave 2 only: April to July 2016</p> <p>9 mailings to caregivers and 7 directed at youth</p>	<u>Fidelity:</u> high
Policy <sup>224</sup>	Work with city stakeholders to support policies for a healthier food environment in Baltimore, and to sustain BHCK activities	- Evidence-based information to support the development of policies at the city level using agent-based models to simulate impact to aid stakeholder decision-making (e.g. urban farm tax credit)	BHCK policy working group formed by BHCK-interventionists and research group, city councilmen, food policy director, wholesaler manager, Recreation and Parks Department, Health Department.	<p>July 2013 to July 2016</p> <p>10 meetings (2h) with stakeholders (every 4 months)</p>	<p><u>Reach:</u> high</p> <p><u>Dose delivered:</u> medium</p> <p><u>Fidelity:</u> medium</p>

**Table 6.2:** Formation of Exposure Scores by B'more Healthy Communities for Kids intervention materials and activities.

Intervention Component	Intervention Material or Activity	Coding of Exposure Score	Observed mean scores (SE) <sup>a</sup>	
			Intervention	Comparison
Communication Materials	<b>Seeing BHCK Logo in different places</b> (stores, recreation centers, carryout restaurants, social media)	None = 0 1-2 places = 1.5 3-5 places = 4 6 or more = 6	0.86 (0.05)  Range: 0- 3.2	0.27 (0.03)  Range: 0 - 2
	<b>Posters</b> (10 questions)	For <u>each</u> poster: Yes = 1 Maybe = 0.5 No = 0		
	<b>Handouts</b> (9 questions)	For <u>each</u> handout: Yes = 1 Maybe = 0.5 No = 0		
	<b>Giveaways</b> (17 questions)	For <u>each</u> giveaway: Yes = 1 Maybe = 0.5 No = 0		
Food Environment	<b>Seeing shelf-label</b> in different stores (BHCK corner stores and carryouts) <sup>b</sup>	None = 0 1-2 places = 1.5 3-5 places = 4 6 or more = 6	0.42 (0.03)  Range: 0– 2.9	0.23 (0.04)  Range 0 – 2
	<b>Taste tests</b> (10 questions) (and 4 cooking demos at recreation center – applied to child only)	For <u>each</u> taste test: Yes = 1 Maybe = 0.5 No = 0		

**Table 6.2 continues**

**Table 6.2 continued**

Intervention Component	Intervention Material or Activity	Coding of Exposure Score	Observed mean scores (SE)	
			Intervention	Comparison
Food Environment (Cont.)	<b>Educational Display</b> (5 questions)	For <u>each</u> display: Yes = 1 Maybe = 0.5 No = 0		
	<b>Seeing redesigned menu</b> (8 questions)	For <u>each</u> menu: Yes = 1 Maybe = 0.5 No = 0		
	<b>Purchased in a BHCK corner store</b> in the past 7 days	Continuous variable: total frequency of purchase summed for all stores (n=21)		
Social Media	<b>Follow or enrolled in BHCK social media</b> (Facebook, Instagram)	For <u>each</u> account: Yes = 1 No = 0	0.08 (0.01)	0.04 (0.01)
	<b>Seeing BHCK posts</b> (Facebook or Instagram) (8 questions)	For <u>each</u> post: Yes = 1 No = 0	Range: 0 – 1	Range 0 – 2
Text-Message	<b>Weekly frequency of receiving a BHCK text message</b>	None = 0 1/week = 1 2/week = 2 3 or more/week = 3	0.55 (0.02)	0.26 (0.02)
			Range 0 – 1	Range 0 – 1

**Table 6.2 continues**

**Table 6.2 continued**

Intervention Component	Coding of Exposure Score	Observed mean scores (SE)	
		Intervention	Comparison
<b>Overall BHCK Exposure Score</b>	1. Added points within each intervention material/activity according to number of questions	1.9 (0.08)	0.82 (0.07)
	2. Re-scaled exposure to material/activity to 0-1 range	Range 0– 6.4	Range 0– 6.7
	3. Summed all re-scaled exposure scores by intervention components		

Abbreviations: SE, standard error; BHCK, B'more Healthy Communities for Kids

<sup>a</sup> p-value based on two-tailed t-test comparing mean scores between intervention and comparison groups. Communication Materials (p<0.001); Food Environment (p<0.001); Social Media (p=0.06); Texting Program (p<0.001); Overall Exposure Score (p<0.001).

<sup>b</sup> we asked participants the number of places where they saw the BHCK logo or saw a BHCK shelf-label at a corner store with four answers (None; 1-2 places; 3-5 places; 6 or more). When coding, we chose the average number in the range of places they reported seeing the intervention materials (i.e., 0, 1.5, 4, 6, respectively). Then, we re-scaled the points to range from 0 to 1 to make all the intervention materials exposure score equivalent before summing by exposure components (communication materials, food environment, social media, and text messages).



**Table 6.3:** Baseline characteristics of the B'more Healthy Communities for Kids adult caregiver sample

Baseline characteristics	n (516)	Intervention (n= 280)	Comparison (n= 247)	p
<b>Caregiver</b>				
Gender – female (%)	469	53.30	46.70	0.39
Age (years) – mean (SD)	515	38.20 (8.63)	40.60 (9.87)	<b>0.01</b> *
African American (%)	478	48.84	43.80	0.99
Education level				
< High school (%)	90	58.89	41.11	0.43
High school (%)	207	52.17	47.83	
> High school (%)	218	50.92	49.08	
BMI (kg/m <sup>2</sup> ) – mean (SD)	512	34.18 (8.05)	33.04 (7.31)	0.09
Normal weight (%)	65	55.38	44.62	0.82
Overweight (%)	99	50.51	49.49	
Obesity (%)	344	52.62	47.38	
<b>Household</b>				
Individuals in the household - mean (SD)	516	4.63 (1.66)	4.53 (1.62)	0.49
Annual income (US\$)				
0-10,000 (%)	120	13.76	9.50	0.13
10,001-20,000 (%)	117	10.08	12.60	
20,001-30,000 (%)	93	10.08	7.95	
>30,000 (%)	186	18.80	17.25	
Food security <sup>a</sup>				
Food secure (%)	302	55.88	61.48	0.19
Food insecure (%)	214	44.12	38.52	
Food assistance participation				
SNAP (%)	516	75.00	70.49	0.25
WIC (%)	516	21.69	22.13	0.90

**Table 6.3 continues**

**Table 6.3 continued**

Baseline Characteristics	n (516)	Intervention (n= 280)	Comparison (n= 247)	p
Housing arrangement				
Living w/ family or other (%)	53	8.46	12.30	0.34
Rented (%)	353	70.22	66.39	
Owned (%)	110	21.32	21.31	

Abbreviation: SD, standard deviation; BMI, Body Mass Index; SNAP, Supplemental Nutrition Assistance Program; WIC, The Special Supplemental Nutrition Program for Women, Infants, and Children

<sup>a</sup> Food security classified according to USDA ERS measure. Food secure households encompassed high food security and marginal food security. Food insecure households were either low food secure or very low food secure.

<sup>\*</sup> *Intervention groups are statistically different ( $p < 0.05$ ) when comparing the proportion of adult characteristics using the chi-square test or means with two-tailed t-test.*

**Table 6.4:** Impact of the B'more Healthy Communities for Kids intervention on food-related behaviors among adult caregivers:  
Average-Treatment-Effects analysis

Caregiver food-related behaviors	Predictive Baseline				Predictive Post-intervention				Pre-post change: difference <sup>c</sup>	p
	Intervention		Comparison		Intervention		Comparison			
	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Effect (95% CI)	
<b>Acquisition</b> (frequency/day) <sup>c</sup>										
Healthful food score	1.48	0.07	1.49	0.06	1.37	0.07	1.43	0.06	-0.05 (-0.22; 0.12)	0.57
Unhealthful food score	1.29	0.06	1.40	0.07	1.21	0.06	1.34	0.10	-0.01 (-0.23; 0.19)	0.87
<b>Home meal preparation</b>										
Frequency of meal preparation (monthly)	33.82	2.24	36.79	1.87	32.69	1.34	38.82	2.36	-3.12 (-9.11; 2.81)	0.30
Healthful cooking score	-0.01	0.04	-0.11	0.06	0.02	0.07	-0.06	0.07	-0.01 (-0.24; 0.20)	0.88
<b>Daily Consumption</b> (srv/day) <sup>d</sup>										
Total fruit	1.10	0.07	1.46	0.25	0.96	0.14	1.78	0.16	0.15 (-0.36; 0.66)	0.55
Total vegetable	1.23	0.04	1.44	0.11	0.94	0.02	1.29	0.17	-0.13 (-0.54; 0.25)	0.51
Total fruit and vegetable	2.33	0.08	2.92	0.29	1.90	0.14	2.44	0.23	0.07 (-0.42; 0.53)	0.78

Abbreviations: SE, standard error; CI, confidence interval; srv, servings

<sup>a</sup> Multilevel models were conducted with Stata 13.1 package with the maximum likelihood option and corrected missing data using the inverse probability weighted method (n=516 for purchasing and n=226 for consumption). Multilevel models are good approach to be used under the missing at random assumption, as it models both the means and the random effect jointly.

<sup>b</sup> In all models: treatment group was coded as comparison (0) and intervention (1); time was coded as baseline (0) and post-intervention (1); standard errors were corrected for clustering for repeated measures from the same individual and BHCK neighborhood (from 1 to 30).

<sup>c</sup> Mean difference in change over time for intervention compared to control adult caregiver

<sup>d</sup> Fruit and Vegetable intakes were estimated via the Quick Fruit and Vegetable Screener from the National Cancer Institute's Eating at America's Table Study (EATS) study. Sample size (n) = 226

<sup>e</sup> Food acquisition frequency (daily) was estimated via a pre-defined list containing 100% fruit juice, apples, bananas, oranges, other fresh fruits, frozen fruits, canned fruits, fresh vegetables, frozen vegetables, and canned vegetables (excluding potatoes). Adults reported frequency of purchasing these items in the previous 30 days.

**Table 6.5:** Correlation between exposure to B'more Healthy Communities for Kids intervention on change in food-related behaviors and fruit and vegetable consumption among low-income African American adult caregivers: Treatment-on-the-Treated-Effect analysis

Change in food-related behaviors and fruit and vegetable intake <sup>a,b</sup>	Total Exposure Score <sup>d</sup>		
	Mean	SE	95% CI
Healthful food acquisition score (daily frequency)	0.01	0.03	-0.07; 0.07
Unhealthful food acquisition score (daily frequency)	0.06	0.06	-0.06; 0.17
Frequency of home food preparation (days)	1.13	1.50	-1.69; 4.21
Healthful cooking methods score	-0.02	0.05	-0.11; 0.09
Daily total fruit consumption (servings) <sup>c</sup>	0.24*	0.11	0.04; 0.47
Daily total vegetable consumption (servings) <sup>c</sup>	-0.81	0.07	-0.22; 0.06
Daily total fruit and vegetable consumption (servings) <sup>c</sup>	0.16	0.10	-0.11; 0.33

Abbreviation: SE, bootstrapped standard error; CI, bias corrected confidence interval

<sup>a</sup> Change from pre- to post-intervention evaluation, n=370

<sup>b</sup> Multiple linear regression models with bootstrap variance (2000 replications) and clustered by BHCK zone, controlled for adult caregiver's age, sex, income, and household size

<sup>c</sup> Fruit and Vegetable intakes were estimated via the Quick Fruit and Vegetable Screener from the National Cancer Institute's Eating at America's Table Study (EATS) study. Sample size (n) = 184

<sup>d</sup> Mean exposure score: 1.1 (observed range: 0-6.7)

\* Statistically significant at p<0.05

**Table 6.6:** Correlation between exposure to B'more Healthy Communities for Kids intervention components on change in food-related behaviors and fruit and vegetable consumption among low-income African American adult caregivers: Treatment-on-the-Treated-Effect analysis

Change in food-related behaviors and fruit and vegetable intake <sup>a,b</sup>	Communication Materials Exposure Score <sup>d</sup>			Food Environment Exposure Score <sup>e</sup>			Social Media Exposure Score <sup>f</sup>			Text Messaging Exposure Score <sup>g</sup>		
	$\beta$	SE	95% C.I.	$\beta$	SE	95% C.I.	$\beta$	SE	95% C.I.	$\beta$	SE	95% C.I.
Healthful food acquisition score (daily frequency)	0.01	0.06	-0.14; 0.10	0.02	0.10	-0.19; 0.19	0.28	0.12	-0.16; 0.73	0.03	0.04	-0.04; 0.12
Unhealthful food acquisition score (daily frequency)	0.03	0.11	-0.17; 0.23	0.16	0.19	-0.21; 0.56	0.47*	0.23	0.02; 0.93	-0.02	0.04	-0.10; 0.06
Frequency of home food preparation (days)	3.31	2.60	-1.94; 8.59	2.52	2.80	-1.98; 9.51	1.41	10.20	-18.54; 21.35	-0.54	1.53	-3.55; 2.47
Healthful cooking methods score	0.03	0.08	-0.14; 0.19	0.07	0.18	-0.31; 0.15	-0.37	0.35	-1.07; 0.33	-0.02	0.05	-0.12; 0.08
Daily total fruit consumption <sup>c</sup>	0.22	0.17	-0.06; 0.59	0.55	0.34	-0.26; 0.10	3.16*	0.92	1.33; 4.99	0.02	0.15	-0.30; 0.31
Daily total vegetable consumption <sup>c</sup>	-0.14	0.11	-0.38; 0.06	-0.15	0.18	-0.54; 0.18	-0.21	0.93	-2.02; 1.48	-0.01	0.13	-0.26; 0.25
Daily total fruit and vegetable consumption (servings) <sup>c</sup>	0.07	0.18	-0.31; 0.43	0.40	0.39	-0.71; 0.95	2.94*	1.01	0.96; 4.93	0.25	0.21	-0.39; 0.44

Abbreviation: SE, bootstrapped standard error; CI, bias corrected confidence interval

<sup>a</sup> Change from pre- to post-intervention evaluation, n=370

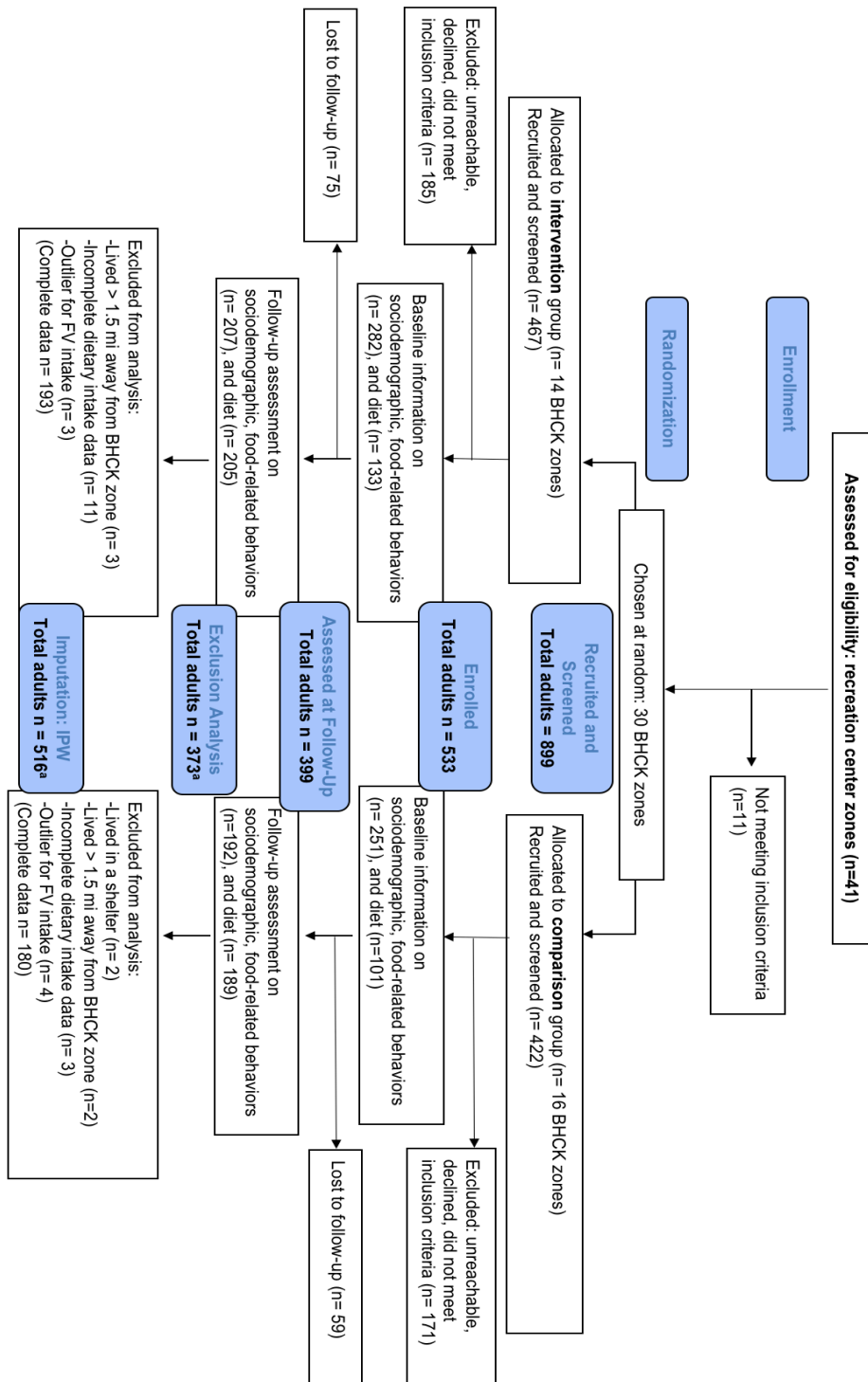
<sup>b</sup> Multiple linear regression models with bootstrap variance (2000 replications) and clustered by BHCK zone, controlled for adult caregiver's age, sex, income, and household size

<sup>c</sup> Servings of fruit and vegetable intakes were estimated via the Quick Fruit and Vegetable Screener from the National Cancer Institute's Eating at America's Table Study (EATS) study. Sample size (n) = 184

<sup>d</sup> Communication material score mean: 0.6 (observed range: 0-3.1); <sup>e</sup> Food environment intervention exposure score mean: 0.3 (observed range: 0-3.1); <sup>f</sup> Social media/texting exposure score mean: 0.2 (observed range: 0-2); <sup>g</sup> Texting exposure score mean: 1.1 (observed range 0-3)

\* Statistically significant behavioral change at  $p < 0.05$ ; Omega-squared ( $\omega^2$ ) estimates of the proportion of the variance in the unhealthful food acquisition, fruit, and fruit and vegetable intake which is due to the variance in the social media exposure score (effect size) = 0.005; 0.04; 0.02, respectively.

## 6.7 Figure for Chapter 6



**Figure 6.1:** CONSORT flowchart of the randomization and course of the B'more Healthy Communities for Kids intervention



<sup>a</sup> Analyses accounted for missing data and selection bias using inverse probability weighted (IPW) method, with the probability of being observed at follow-up as a function of the characteristics of caregiver (age, sex, and income) and study wave; final imputed sample size in the multilevel analysis  $n = 516$ .

## **Chapter 7. Discussion and Conclusions**

This chapter provides a summary of the main findings in relation to the dissertation aims, draws overall conclusions, ties the study into the multilevel multicomponent literature, and discusses the strengths and limitations of the study, and describes the implications from this study for future research, theory, and public health policies.

### ***7.1 Summary of findings***

The overarching goal of this proposal was to conduct a sub-analysis of the BHCK intervention to evaluate how a multilevel, multicomponent obesity prevention intervention impacts diet and food-related behaviors of low-income urban, predominantly African American youth and their adult caregivers living in neighborhoods with low access to healthful foods. In this section, the main findings are summarized according to the specific aims of this dissertation.

***Specific Research Aim 1:*** *To evaluate the patterns and determinants of exposure ('dose received') to BHCK materials and activities among youth and their caregivers.*

- **Research Question 1:** What were the patterns of exposure (dose received) to BHCK intervention materials and activities among youth and caregivers?
- **Research Question 2:** How did patterns of overall dose received differ by treatment group among youth and their caregivers?
- **Research Question 3:** What individual and household factors are associated with exposure to the BHCK intervention?

Exposure to different BHCK activities and materials appeared to differentiate between youth and caregivers, and by wave of implementation. Caregivers had greater scores of exposure to BHCK logos, handouts, giveaways, and to the social media program (Facebook, Instagram, and texting). High caregiver exposure score for the social media component was not surprising, as this intervention component was especially targeted at adult caregivers. Exposure to the BHCK logo and giveaways were also high among the youth sample; however, exposure to BHCK educational displays was higher in the youth sample compared to the caregivers. Educational displays were utilized mainly in recreation center sessions led by youth-leaders (college and high school mentors) attended by the youth population, and in-store nutrition sessions that were public and available to all community members. Both youth and caregivers presented higher overall exposure to BHCK during wave 2 compared to wave 1. This finding was expected, as the BHCK team used information collected from wave 1 post-intervention exposure and lessons learned to improve program and materials in wave 2. Previous studies have reported using process evaluation measurements to guide midcourse corrections and to ensure that the intervention is reaching the intended study population.<sup>189,255,258</sup>

Overall BHCK exposure score was low in both the intervention and comparison groups. Interestingly, a small portion of the comparison group reported being moderately or highly exposed to BHCK, which indicates that contamination bias likely occurred. Yet, mean exposure scores in the intervention group was statistically significantly higher than the mean exposure score in the comparison group. Other community-based group-randomized controlled trials studies have also reported overall low exposure to the intervention by the study population.<sup>185,191,239</sup> Furthermore, the issue of contamination has

been previously reported in other behavioral intervention studies using group randomization.<sup>323</sup> Future studies should account for intra-cluster correlation in sample size calculations in order to ensure significant power to cope with contamination.<sup>324</sup> For instance, it has been estimated in the literature that a contamination of 30% can be sustained before the sample size of the study has to be doubled to account for the reduced mean effect size.<sup>324</sup>

Being a younger youth, from a household with higher annual income (>\$30,000) and being a female caregiver were factors associated with higher likelihood of exposure to the BHCK study. This finding sheds light on the importance of recognizing that sociodemographic characteristics of the study population may confound participation in the program, which can later influence behavioral outcomes. This information is also important to help researchers to understand representativeness of the study and how the intervention reaches its intended audience.<sup>262</sup>

***Specific Research Aim 2:** To evaluate the impact of the BHCK intervention trial on food consumption, preparation, and acquisition among low-income urban African American youth.*

- **Research Question 1:** What was the impact of the multilevel BHCK intervention on purchasing behavior of healthier and unhealthier food items among youth?
- **Research Question 2:** What was the impact of the intervention among youth on the consumption of high-sugar, high-fat snacks and beverages?
- **Research Question 3:** How did the impact of the intervention differ between younger (9-12 years old) and older youth (13-15 years old)?

There was a significant positive effect of the intervention on the variety of healthier food purchased among intervention youth versus comparison youth. By the end of the intervention, youth in the intervention group acquired one additional healthier item than the comparison youth. Healthier foods and beverages included low-fat, low-sugar drinks (e.g., 1% or skim milk, water, 100% fruit juice, sugar free drinks), and low-fat, low-sugar snacks (e.g., fresh fruits and vegetables, low sugar/high fiber cereals, pretzels, baked chips). This finding is supported by our other results, as BHCK was successful in improving availability of healthier foods and beverages in small food stores in intervention zones, indicating that food availability and promotion at the point-of-purchase may have shaped people's food choices.<sup>275</sup>

However, the BHCK intervention increased both healthier and unhealthier food purchasing variety among children 9-12 years of age. This result indicates that this age group did not reduce the variety of unhealthier food items purchased, even though improving healthier food availability in the community environment impacted both overall and younger youth in terms of healthier food purchasing behavior. It is possible that other social and household factors influenced youth to purchase either more healthy or unhealthy foods than the environmental factors accounted for in the BHCK intervention. Another possible explanation is that older youth tend to be more responsible for their own decision making<sup>325</sup> and also have more pocket money than younger youth, which increases youth's purchasing power and may influence substitution of unhealthier foods for healthier foods.<sup>283,326</sup>

The age-stratified analysis demonstrated that BHCK decreased kcal intake from sweet snacks among intervention adolescents by 3.5% compared to their counterparts.

This is important given that sweet snacks are among the most frequently purchased items by youth in corner stores, as reported by Dennisuk and colleagues.<sup>116</sup> Additionally, Hager et al. have demonstrated that adolescents living in food deserts and food swamps in Baltimore City have higher intake of sweet snacks than those living in areas where access to healthier food is not constrained.<sup>327</sup> Compared to younger youth, older youth have an overall lower dietary quality<sup>279</sup>, experience greater autonomy, and may be more influenced by the community food environment.<sup>280</sup>

Analogically, the decrease in 3.5% kcal from sweet snacks can be translated into one fewer chocolate chip cookie or three fewer pieces of Starburst per day (about 63 kcal/d). According to the conventional model<sup>328</sup>, a decrease in balance between intake and expenditure of 63kcal/d would produce approximately 6.5lb weight loss (22,500 kcal) per year, if intake of other foods remained constant. Taking anthropometric baseline measures as a reference, an average child in the 13-15 years old range from the BHCK sample weighs 140 lbs, is 64 inches tall, and has 24 kg/m<sup>2</sup> units of BMI. The decrease in sweet snacks would reflect a 4.6% change in weight, or 1.1 kg/m<sup>2</sup> per year, if holding other factors constant. Given that adolescents are still growing<sup>2329</sup>, and thus increasing resting metabolic rate (RMR) and total daily energy expenditure (TDEE), the decrease in intake might be even higher as a percentage of needed calories, which would reflect an even greater change in weight or BMI units.

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<sup>2</sup> Age-based ranges for annual height velocity (HV in inches) from a longitudinal sample of US African American adolescents (n=1707) in Philadelphia: **male** age 13 (2.9 inches), age 14 (2.4), age 15 (1.6); **female** age 13 (1.0); age 14 (0.6), age 15 (0.1). 329. Kelly A, Winer KK, Kalkwarf H, et al. Age-based reference ranges for annual height velocity in US children. *J Clin Endocrinol Metab.* 2014;99(6):2104-2112.

***Specific Research Aim 3*** - *To evaluate the impact of the BHCK intervention trial on fruit and vegetable intake, food preparation, and acquisition among low-income urban African American caregivers.*

- **Research Question 1:** What was the impact of the multilevel BHCK intervention on food-related behaviors (purchasing of healthier and unhealthier food items, food preparation and consumption of fruits and vegetables) among adult caregivers?
- **Research Question 2:** Was change in food-related behaviors associated with caregiver's exposure level ('dose received') to the BHCK intervention?
- **Research Question 3:** What component of the multilevel BHCK intervention was correlated with changes in food-related behaviors among caregivers?

In the average treatment effect (ATE) analysis, there was no significant effect of the BHCK intervention on caregiver's food acquisition, home food preparation, and daily consumption of FV among intervention group compared to their counterparts. Although few childhood targeted obesity interventions have measured the impact of the intervention on children's caregivers, the ones that did have reported mixed results. For instance, the *Switch what you Do, View, and Chew* program found a statistically significant impact on FV intake among intervention caregivers<sup>171</sup>, but the *Screen-Time Weight-loss Intervention* did not find any impact on the caregiver-level in terms of BMI and active behavior.<sup>301</sup>

The treatment-on-the-treated-effect (TTE) analysis ('dose received') showed a statistically significant greater intake of daily fruit servings among participants who reported higher exposure to the BHCK intervention. Other studies have also found a

positive correlation between adherence/exposure to the intervention and improvement in TTE analysis.<sup>171,303</sup> The null impact of BHCK on caregiver's behavior may be attributed to 1) the low intervention exposure experienced by caregivers; and/or 2) the contamination of the intervention activities among comparison caregivers, thus attenuating the average effect towards the null in ATE analysis.<sup>303</sup> Therefore, the TTE results, although not causal, demonstrate the importance of achieving optimal dosage of the intervention to influence behavioral change among participants.

When breaking down the BHCK caregiver exposure score into intervention components (i.e., communication materials, food environment, social media, and texting program), we found that a greater exposure to the BHCK social media component was correlated with greater intake of daily fruit servings and unhealthy food acquisition frequency score. From the four BHCK components, the social media and text messaging were the ones that targeted specifically adult caregivers with a tailored and goal-setting approach. The higher reach of the social media component may explain the positive correlation with dietary behaviors, compared to the other intervention components. However, social media was also correlated with increased frequency of unhealthy food purchasing behavior, which may flag a potential unintended consequence of using social media as an intervention venue due to the simultaneous exposure to online advertising for unhealthy foods. Future studies should examine the relationship between public health social media campaigns, advertising exposure, and individual food behaviors.

## **7.2 Overall conclusions**

In conclusion, findings from this dissertation work support evidence of multilevel, multicomponent nutrition intervention program in improving healthier food purchasing



behavior and decreasing caloric intake from less healthful foods, adding to the childhood obesity prevention literature. Furthermore, this was one of the few studies to explore effects of a child-focused obesity prevention intervention on caregiver food behaviors. This work also makes a case for multilevel, multicomponent interventions to consider measuring the extent to which individual study participants report being exposed to the intervention overall and by intervention component. Exposure assessment may inform study's external validity, quantify contamination of the intervention among the comparison group, and provide estimates of the optimal dose and reach of the program that will be correlated with changes in behavioral outcomes. This study was the first to attempt to investigate what component of a multi-layered intervention was most likely to influence behavior change by utilizing exposure score on treatment-on-the-treated-effect analysis. In doing so, the BHCK social media component seemed to be a promising tool to promote healthful behaviors of adult caregivers in the context of a multilevel, multicomponent childhood obesity prevention program.

### ***7.3 Strengths and limitations***

This study improves upon prior research by utilizing a social ecological approach incorporating social cognitive theory with a group-randomized multilevel community-based trial, making it more likely to impact behavior change at individual levels (child dietary and food-related behaviors, and caregiver intakes and food purchasing). The B'more Healthy Community for Kids trial used validated instruments (e.g., Block Kids Food Frequency Questionnaire, the NCI FV screener) conducted by intensively trained data collectors to assess diet and food-related behaviors, thus increasing reliability of the study. Therefore, the collection of accurate measures, the use of a randomized design,

and the detailed description of the study design, implementation, and evaluation, improved internal validity of the study.

To best understand individual's behaviors related to food and beverages in a holistic manner, this dissertation utilized various food metrics (food purchasing, preparation, and consumption). In this study, I conceptualized each food metric connected, but not determined solely by the previous step. For instance, nutrient intake cannot occur without food consumption, which in turn is dependable on how the food is prepared (e.g., if it is fried, there is addition of fat), and subsequently on what foods were purchased or acquired by the individual or someone in the household, which reflects on the types of foods and beverages available in food-retail stores where individuals shop. When evaluating the change of each step of food-related behaviors in relation to the BHCK intervention, it was possible to understand, for example, if BHCK had greater impact on more distal variables of food behaviors (i.e., food purchasing). By evaluating various food metrics, it was possible to observe that youth did not decrease total dietary calories, which could be partially explained by the increase in food purchasing behavior of both health and unhealthy food items.

The use of hierarchical mixed effects models to evaluate the effect of the intervention was also another strength of this study. Under violation of the independence assumption (individuals correlated within clusters and between repeated measures), generalized-estimating equation (GEE) could have also been used to address this dissertation research questions. However, under the assumption of data missing at random (MAR), which was the case of this study, GEE would provide invalid and biased results.<sup>245</sup>

This work is also unique because it built on previous environmental trials and on more than a decade of working in collaboration with the community stakeholders, city agencies, storeowners and wholesalers in Baltimore City. In addition, it adds to the culturally appropriate obesity intervention literature by providing evidence-based information of its effectiveness to improve food-related behaviors among the targeted population. The thorough formative research conducted in this setting paired with the long-term relationship and rapport built have strengthened the intervention delivered through a community-participatory approach. In addition, working intensively with the community and stakeholders from the conception of the study improved the acceptability of the work, and also focused on the sustainability of the intervention components. Given the large sample size used in this study, and that participants were representative of the Baltimore City and African American urban populations, findings from this study might be transferable to similar contexts in the U.S. However, it is important to recognize that a tailored approach might preclude the intervention to be generalizable to other settings or populations. Future multi-site studies are needed to test whether the approach utilized in this study could be successfully replicated in different contexts (other populations, places, times), contributing to an enhanced generalizability.

Limitations to the proposed study should also be noted. First, this study experienced a higher attrition rate than initially projected (25%), thus decreasing the final sample size, despite efforts to avoid high rates of drop-outs (e.g., eligibility criteria included intent to stay within the study areas over the next two years, multiple attempts to contact the families by phone, and using household visits to conduct follow-up surveys). However, during the analysis, when baseline characteristics between individuals with

completed follow-up evaluation were compared with missing informants regarding covariates and outcomes, those youth who had an older and female caregiver were more likely to remain in the study. To address potential selection bias, caregiver's age and sex were added as covariates in all multilevel regression models, and maximum likelihood methods were employed to produce unbiased estimates for data missing at random. Inverse probability weighting (IPW) was employed in the analysis to correct for the effects of missing data.<sup>245</sup>

Second, originally the B'more Healthy Communities for Kids trial had proposed a probability cluster sampling, in which 100 households would be identified for eligibility and interest in participating in the study in each zone, then 24 households would be randomly selected from this initial list for inclusion in the study. However, from the list of eligible participants, nearly all caregivers ended up being contacted and invited to be in the study, so randomization at the individual level was not possible. In order to address this issue, comparison between baseline characteristics from intervention and control groups were assessed, and variables that differed between groups were included in the multilevel regressions to account for potential confounder and minimize selection bias. Nevertheless, selection bias was also ameliorated by having a comparison group of youth sampled from similar neighborhoods.

Third, multilevel multicomponent programs are implemented as synergistic interventions with components reinforcing one another at different levels.<sup>293</sup> However, this limits the researcher's ability to identify which specific component was more successful in influencing behavior change. To address this limitation, this dissertation study proposed the development of Exposure Scores derived from the Intervention

Exposure Questionnaire (IEQ) and used this construct in a secondary impact analysis (TTE approach), as done previously.<sup>10</sup> Although causality cannot be inferred, this analysis may provide information about the dose response relationship between level of exposure to the intervention and behavioral change, and may identify specific intervention components that are more likely to influence the outcomes.<sup>193</sup>

Fourth, although the program was implemented according to initial process evaluation standards, achieving optimal intensity of the intervention (e.g., form of delivery, duration, and frequency) is challenging<sup>284</sup>, and may partially explain the modest impact on dietary intake. In addition, there was some geographical overlap in the intervention and control zones within the 1.5-mile buffer, which might help to explain exposure to the program in the control group, and it may also have attenuated differences between study arms. Despite this overlap, differences in exposure levels between the intervention and control group were still observed.

Fifth, B'more Healthy Communities for Kids trial was conducted in two different waves at different times, which may have resulted in two different interventions. Although the structure of the intervention remained the same across the waves and same evaluation forms were used, improved communication materials and activities were implemented during wave 2 to increase reach and intensity of the intervention based on lessons learned from wave 1. Knowing that, a sensitivity analysis with an additional interaction term to explore potential differences in impact by wave did not show any statistically significant differences between waves (i.e.,  $\beta_2 * (\text{Time})_{ijk} * (\text{Group})_i * (\text{Wave})_{ijk}$ ).

Another limitation of this study might be the risk of social desirability bias by treatment assignment, and by sex, age, and income due to the self-reported

questionnaires. Some participants may have felt the need to inaccurately report that they have been exposed to certain activities or received BHCK materials. To address this issue, BHCK Exposure questionnaire included red-herring questions to improve response's validity. Moreover, data collectors did not participate in the intervention implementation and were masked to the treatment group to avoid measurement error. Estimation of amounts and portion sizes of foods eaten can be challenging, hence we used bowls, plates, cups, and glass of various sizes to aid with dietary intake recall with both youth and adult caregivers and also to minimize response bias.

Lastly, the survey was administered to self-identified caregivers, based on their report that they purchase most of the food and cook for their family members. However, some caregivers may not be the primary food purchasers for their households. Also, the frequency of food purchased at various types of food venues investigated did not take into consideration the quality or quantity of the acquired food. Not all foods were collected in the food purchasing and food frequency questionnaires – possible that youth and caregivers might be purchasing or consuming other foods that were not captured (both healthy and unhealthy). Thus, conclusion of future results should be made with caution and take the abovementioned factors into consideration.

#### **7.4 *Future analysis***

In addition to the three papers that are part of this dissertation, I plan to publish several other papers relating to this work. Future dyadic data analysis will be conducted to explore if changes in food-related behaviors among children were influenced by adult caregiver behaviors, and vice-versa. A multilevel model taking interdependence of distinguishable dyads into consideration will be employed. Another paper would also test

mediation effect of the change in availability of healthy foods (environmental-level) and purchasing and consumption of these foods at the child and caregiver-levels. Moreover, additional analysis exploring different ways to categorize the exposure data (e.g., assigning different weights to each BHCK component or looking at one exposure variable at a time) and relating to changes in food-related behaviors will be conducted. Lastly, impact of BHCK on psychosocial factors (i.e., self-efficacy and intentions to healthy eating) and social support to healthy and unhealthy eating will also be explored.

## ***7.5 Recommendations for future research***

This dissertation research provided novel information to the literature by testing the impact of a community-randomized controlled intervention on improving healthier food-related behaviors. Despite the use of validated instruments and strong study design and analysis plan, the limitations should be addressed in future studies and hypotheses of the pathways of unexpected results should also be tested and confirmed. Below, potential strategies for addressing important limitations of the study and further recommendations are presented.

### **7.5.1 Engage and target families and caregivers in childhood obesity interventions**

This dissertation showed that adult caregivers of children participating in a childhood obesity prevention intervention benefit from the program. Caregivers who were more exposed to the intervention improved consumption of fruits. However, few childhood obesity prevention interventions have assessed impact of the intervention at the caregiver or family level. Understanding the impact of childhood obesity prevention on

caregivers is important because child-focused interventions may have a spill-over effect on their family members, as children may act as a change agent.

BHCK was an intervention that sought to modify the out of school food environment and engage families through social media. Childhood obesity prevention programs that also engaged adult caregivers have shown more positive child-related outcomes than child-only interventions.<sup>93,94</sup> Although children at the age of 9-15 years old are becoming more influenced by their peers and the community and gaining more independence from their families, the family environment still plays an important role in their behavior. Families' eating practices, rules, and support influence children to initiate and sustain positive dietary changes, while providing opportunities for social learning. Furthermore, foods eaten at home still comprise more than 60% of children's caloric intake.<sup>67</sup>

Recognizing the importance of the household environment, BHCK experimented various ways to involve families beyond social media. For instance, BHCK tried to approach parents at recreation centers at pick-up hours, but few parents actually walked in the participating centers. BHCK also organized a family cooking session for the wave 2 families at the Rita Church recreation center on a Saturday afternoon. Families of children attending all BHCK intervention recreation center (ages 9-15) were invited – but only five families attended. These efforts demonstrate that it was challenging to engage families in a group or community setting. The BHCK mailing component implemented mid-way through wave 2 was another way to reach and involve caregivers in the intervention.



Therefore, future studies aiming at preventing childhood obesity among underserved communities should consider intervening in both community and household food environments. *Challenge!* was an example of a home and community-based obesity prevention program targeted at African American adolescents (11-16 years old) in Baltimore City.<sup>211</sup> Despite difficulties in following up families, the study was successful in decreasing obesity prevalence and snack/dessert consumption among intervention adolescents.<sup>179</sup> Another study, *Aventura Para Niños*, also intervened in both community and home environment, but had no effect on children's BMI.<sup>330</sup> Authors attributed the null effect to the low intensity of the intervention (~5 home visits over a 3 year period) and the high attrition rate.<sup>330</sup> It is also recognized that intervening in both community and home environments is a resource-intensive approach, and that achieving optimal intensity of the program could still be a challenge given the difficulties in conducting home visits frequently and consistently. Future studies could include tailored goal-setting social media, texting, mailing, and phone calls in home visit programs to maintain contact with the families.<sup>303</sup> More research is needed to test such approach.<sup>331</sup>

### **7.5.2 Longer duration of the implementation of the intervention**

Although BHCK was a five-year funded program, implementation of the intervention occurred for six months and eight months (wave 1 and wave 2, respectively). In the context of a large, multi-layered intervention trial, a lot of time is needed to build rapport with the community, to develop intervention materials and data collection instruments, and to conduct baseline and follow-up interviews. BHCK program implementation could have been longer in duration if the intervention had occurred in only one wave, instead of two (total of fourteen months). However, the decision to

implement the intervention in two rounds were due to lack of resources needed to intervene in 14 neighborhoods at once in an effective manner. Instead, BHCK was implemented in two rounds to allow people and resources available to focus on 7 intervention neighborhoods at a time. Implementation in two rounds also allowed the research team to improve materials and intensity of the program for wave 2, after taking lessons learned and process evaluation results from wave 1 into consideration.

Conversely, it has been hypothesized in the literature that longer duration of an intervention may be needed to promote and maintain behavior change.<sup>332</sup> Short-term duration studies are usually defined as 12-week duration and long-term studies are at least one year long. Although a previous Cochrane metaanalyses comparing the effect of a childhood obesity interventions on BMI change did not find a statistically significant difference between short- and long-term studies<sup>9</sup>, short-term effects may be specious and not maintained. Therefore, longer follow-up measures are needed in future studies to evaluate whether the behavior were sustained over the longer term.

### **7.5.3 Increase dose and reach of the intervention**

Another important consideration for community-based interventions is related to achieving optimal dose and reach of the program that will be likely to promote behavior change. Although community-based environmental interventions are thought to reach more people than individual- and household-level interventions, it usually has lower dose. However, when intervening simultaneously in multiple levels of the socioecological model (e.g., MLMC interventions), it is hypothesized that there will be a gain in intensity and dose due to the synergistic and combined effect of intervening in multiple settings, than intervening in only one setting.<sup>293</sup> For instance, by intervening in multiple settings

that are key components of the community food environment, the intervention is likely to reach its intended population with higher frequency and intensity. However, the more settings a research team has to intervene on, more resources and evaluations will be required.<sup>187</sup> It might be a trade-off between intervening in more levels with lower intensity (but expect a gain in the combination effect), or at fewer levels with higher intensity.

Nevertheless, this dissertation has shown that, even in MLMC interventions, the chances of reaching the study population are low (e.g., 15% of the intervention group had low or very low exposure to BHCK) and that conducting detailed process evaluation during the implementation is essential for understanding how much the population is receiving the program. For example, BHCK used information on exposure from wave 1 to inform midcourse corrections of the activities and materials utilized during wave 2. Posters increased in size and nutrition education sessions increased in length of duration. Future studies should conduct process evaluation during pilot/feasibility trial to assess and test optimal intervention dose. There is also a need for better documentation of process evaluation in terms of adherence to initial intervention protocol and actual implementation (e.g., number of household visits planned may have not been the number of household visits actually conducted during the program). Among the process evaluation measures, dose received (exposure) is one of the least commonly measured and reported, but may be used to improve quality and dose of the intervention implementation.

#### **7.5.4 Minimize selection bias and contamination bias**

Group-randomized controlled trials require larger sample size than individual-randomized controlled trials to achieve statistical power to assess intervention effect due to the increased correlation between individuals from the same cluster or group.

However, two important sources of bias that are usually underreported in the literature of group-randomized controlled trials and attenuate the intervention affect are: missing data<sup>333</sup> and contamination of the comparison group.<sup>324</sup>

In a recent systematic review of the literature on group-randomized-trial, it was identified that missing data is presented in most trials, but usually not considered during analysis.<sup>333</sup> Missing data not only decreases the final sample size, but also may be an important source of selection bias if not handled correctly. An estimation of drop-out rates is usually taken into consideration in a priori sample size calculations, therefore, studies should not omit this information, as it helps to inform future trials. In BHCK attrition rates were higher than estimated in the original sample size calculation, thus, future studies in this setting should estimate a loss to follow-up of about 30%. It is also important to minimize selection bias in the analytical stage and to report the assumption of the missing data.

In addition, more than 10% of the BHCK comparison participants were moderately or highly exposed to the intervention materials and activities. The contamination was likely to exist because clusters were defined by the researchers and randomized, rather than according to specific community boundaries. Furthermore, the choice of having 1.5-mile radius for the randomized cluster resulted in considerable overlap between the BHCK zones. An alternative to this approach would be to reduce the

radius of each zone to 1.0 or 0.5-miles to avoid overlap. However, a shorter radius would decrease the chances of finding enough eligible families to participate in the study, or corner stores and carryout restaurants present in the area. Another option would be to maintain the 1.5-mile radius for the zone, but ensure no overlap. This would probably result in a reduced number of zones to be randomized, which would require a greater number of individuals in each cluster for an appropriate intervention effect size. On the other hand, this could create an opportunity to work with neighboring cities. Nonetheless, there is still greater potential for contamination by randomizing neighborhoods within city boundaries, given that individuals often travel more than two miles to go to work, school, or grocery shopping. Contamination should be also taken into consideration at sample size calculations by estimating higher intra-class correlation values.

#### **7.5.5 Assess quantity of food purchased by caregiver and youth**

The household food environment is an intermediate level between the retail environment and individual food consumption.<sup>334</sup> Therefore, it is important to understand the factors that influence individual food choices and what is available in the home environment, that may help explain unhealthful food patterns.<sup>334</sup> BHCK surveys were comprehensive as it covered a wide range of topics (i.e., food purchase, diet, psychosocial factors, social support, food insecurity, sociodemographic, health beliefs and attitudes, etc.). In order to reduce respondent burden, measure of frequency of food purchased was not extensive, and focused on the foods promoted/discouraged by the intervention, did not take into consideration the quality or quantity of the acquired food/beverage, and did not assess the amount of money spent in each food type or group. Nevertheless, future studies should collect information on frequency and quantity of food

purchased, as it allows researchers to estimate nutritional quality and profile of the foods usually purchased and brought for the household. A challenge that may emerge when collecting information on food purchased is that individuals usually acquire the same item (e.g., soda) in different quantities (i.e., can, 12oz bottle, cup, packs). Whenever possible, surveys should be able to inquiry quantities in different sizes, or to select a size that is the most commonly purchased by the population.

In the current literature, food purchasing has been estimated using a variety of methods, such as household food inventories, food purchase records, grocery store receipts, and bar code scanners.<sup>335</sup> However, each method has its own limitation. Although grocery store receipts provide data on type, quantity, expenditure, and location of purchase, it does not provide information on foods and beverages acquired in convenience stores, corner stores, pantries, farmers market, or donated by family/friends. Weekly annotated receipts filled by the main household shopper could be an alternative method to acquire food purchasing in a range of food sources.<sup>336</sup> Conversely, bar code scanners may be an easy method for the respondent to use, but it is costly and complex for population-based studies.<sup>337</sup> Furthermore, it does not capture food and beverage items that are not pre-packaged (e.g., fresh fruits and vegetables). Nonetheless, a combination of at least two methods could be used (e.g., inventory and annotated receipts) to improve accuracy of data capture, and type of method used should be aligned with the research question of each study.

#### **7.5.6 Plan for program sustainability**

Sustainability of an intervention should be planned and measured from the early conceptions of the study. Many community programs have focused only on program

efficacy rather than looking at the long-term viability of the program success, thus failing to maintain the advances and positive results after the program is over.<sup>208,338</sup>

Formative research is a component of the intervention that is essential to ensure appropriateness of the program and to develop a meaningful and effective evaluation of the intervention to ensure continuity.<sup>339</sup> Training of community participants to build capacity and enhance likelihood of institutionalization of the program are some ways to achieve sustainability and ensure that the program will not have an unexpected termination.<sup>228</sup> The sustainability plan for BHCK has evolved differently by each intervention component:

Corner Stores: In 2009, the mayor of Baltimore formed a food-policy task force to improve the city's food environment by hiring a food policy director and developing a series of recommendations to improve the city's food environment – one of them was the Plan for Baltimore Corner Store Program Expansion with collaboration between different stakeholders and the Baltimore Food Policy Initiative (BFPI). The corner store component is recently being carried on by the Baltimore City Health Department, as part of the *Baltimarket* program. The program used lessons learned from BHCK and BHS projects to provide owners with technical assistance, marketing materials, and incentives and infrastructure to enable stocking of healthy foods. The program promotes foods in the following categories: whole grains, vegetables, fruits, low-fat dairy, healthy snacks, and healthy beverages. *Baltimarket* works with corner stores located in four zip code areas at a time and BHCK staff assist with the evaluation of the program.

Carryout Restaurants: Strategies used as part of the BHCK carryout component and BHC were adapted and implemented in Baltimore Public Markets as *Get Fresh*

*Public Markets* program. The program is a collaboration between BFPI, and Baltimore Public Market Corporation that was pilot tested in Lexington and planned to be disseminated to all six public markets. The program utilizes the green leaf logo for signaling healthier choice and also provide redesigned menus to participating carryout restaurants.

Recreation Center/Peer Mentoring: During the implementation of BHCK wave 2, interventionists provided five training sessions to recreation center directors to build capacity of the center. Each center received the BHCK nutrition curriculum and materials utilized in the 14-sessions with children. The BHCK nutrition curriculum was adapted and incorporated as part of the Recess Baltimore program, led by the American Heart Association (AHA). Recess Baltimore works with six different recreation centers every year, provide technical assistance to center's directors and evaluate the program where directors lead nutrition sessions with children following AHA's curriculum. Furthermore, BHCK also partnered with University of Maryland Extension (SNAP-Ed) and they will identify recreation center staff that are characterized as champions of healthy eating to undergo the "Champions for Healthy Kids Training".

Policy: The policy working group engaged 40 participants representing city departments, councils, and community stakeholders. This component was created with the main goal to sustain BHCK program elements and engage stakeholders in this conversation from the beginning of the program. Most of the actions to sustain BHCK components described above started within this group and by partnering with existing health programs. Even after completing the program, BHCK team has provided continue support to Baltimore City stakeholders, especially through Systems Science modeling to



inform policies. For example, Baltimore City is considering a Staple Foods Ordinance, similar to the Minneapolis Ordinance model. The team has been working with the Food Policy Director of Baltimore City, Holly Freishtat, and the Health Department to provide them with a tool to guide the development of the ordinance in terms of types of foods and different quantities that should be enforced by the ordinance to improve availability of healthy foods in low-income areas.

Social media: Facebook, Instagram, and Twitter accounts created for the BHCK program are still live and active and being managed by graduate students from JHSPH. Those accounts are currently being used to maintain connection and relationship with the community, and at the same time continue to promote events and information associated with wellness. Findings of the BHCK program have been disseminated to the community via these social media accounts.

## ***7.6 Implications for theory***

The findings from this dissertation can be explained in part by the socio cognitive theory and the socio ecological model. For instance, youth and their caregivers may have improved their food-related behaviors from being exposed to nutrition education and food demos that may have increased their intentions to healthy eating, leading to a behavior change. Additionally, changes in the food environment (increased availability of healthier foods) may have also played a role in behavior change, according to SEM.

However, this work has also demonstrated that individuals experience a nutrition intervention differently given the extent of exposure to the program and activities individuals are exposed. Yet, no theory recognizes the optimal amount and duration needed to influence behavior change. This may be because most studies seeking to

explain the effect of health behavior theories are cross-sectional.<sup>340</sup> Future analysis of this dissertation work could also estimate the variation in behavior change explained by the socio cognitive model by testing the hypothesis that behavior change was mediated by cognitive changes (i.e., self-efficacy, intentions).

Similar interventions could consider applying a transtheoretical approach<sup>136</sup> to promote health behavior change adoption and maintenance by classifying individuals into the five stages of their readiness to change and tailor programs and messages<sup>341</sup> (e.g., delivered through texting messages, mailing, or social media). For those in the first stage of precontemplation, a longer duration and higher intensity of the intervention may be needed until the adoption of the new behavior. Conversely, for those in the third stage, of preparation, a shorter and lower dose and intensity of the intervention may trigger behavior change.

## ***7.7 Recommendations for policy***

This work has public health policy-related implications for combating the complex issue of childhood obesity. Policy solutions should build multilevel include multi-faceted actions – by targeting the city-level to improve the community food environment to enable residents to make healthier choices, and at the same time, reach individuals by improving self-efficacy, intentions, and nutrition knowledge. This dissertation, for example, has shown that working with small-retail owners to increase stocking of healthful foods is feasible, and when paired with promotions to consumers we are able to shape individual's food choice and consumption, especially in areas with low access to supermarkets. These results can help in conversations with store owners to improve their adherence and support of the proposed new SNAP depth of stock by

demonstrating that stocking healthy foods may result in improved purchasing and consumption of healthful foods among vulnerable children. The SNAP depth of stock sets a minimum standard for stocking 36 staple foods for stores to be eligible to accept SNAP benefits from their clients. This rule aims to improve low-income individual's access to nutritious foods. However, findings from this dissertation suggest that stocking requirements should be combined with store owner training and social marketing strategies to promote individual behavior change.

The Healthy Food Availability Index is a measure of the presence of healthy and staple foods that assigns scores from 0-100 to a food retail.<sup>214</sup> Grocery stores usually have a score of 20 points or higher, whereas corner stores have an average of 9.8 points, and convenience stores of 6.3. Baltimore uses HFAI scores as one of the four criteria for defining a Healthy Food Priority Area (previous known as food desert).<sup>215</sup> Furthermore, it is known that more than 80% of Baltimore corner stores accept SNAP (i.e., meet current SNAP stocking requirements), but still have the lowest HFAI scores among all food-retail store types. Hence, encouraging corner stores to accept SNAP is important to ensure that low-income individuals have access to foods, but may be not enough to improve equal access to healthy foods. BHCK intervention in corner stores successfully improved HFAI score by an average of 5 points, demonstrating that the intervention was feasible and effective in improving the healthy food environment.<sup>275</sup> Future policies should consider the strategies utilized by BHCK and the foods promoted to improve Healthy Food Availability Index in small food retailers that are predominate in low-income settings. Currently, Baltimore is considering implementing a Staple Foods Ordinance – city stakeholders could use evidence from BHCK to select food items and

quantities for the ordinance, utilize training materials for owners, and promotional materials for consumers to better enforce the ordinance and encourage stocking of healthier foods, as a form of regulation. The HFAI may be an important tool to assess effectiveness of policies to improve availability of healthier foods in small retail food stores in low-income neighborhoods. Thus, improving HFAI score may be one strategy to improve Baltimore food environment.

Despite positive results on the impact of BHCK on healthy food-related behaviors, effects were relatively small and increases in unhealthful food purchasing were also seen. Implementing policies that restraint unhealthy food purchases may be a critical step to produce meaningful improvements in diet. Many lab-based simulated online food purchasing surveys have taxed unhealthful foods and reduced healthier foods prices by 12.5-25%<sup>342</sup>, or 25-50%<sup>343</sup> and found a decrease in calories purchased and increase in healthy food purchased, respectively. Sugar sweetened beverage taxes in Berkeley (CA, U.S.A.) and Mexico are examples of policies that decreased sales of taxed foods, purchase, and increased consumption of water.<sup>344,345</sup> More U.S. cities and states have implemented taxes on SSBs or junk foods in the past year, but opposition against this policy is still large, with arguments that SSB is not the right solution, that the tax will harm and marginalize mainly the poor, and that it might affect negatively small business.<sup>346</sup> Other policies to curb unhealthy food purchasing include restrictions on marketing, and health warning labels on unhealthy foods and beverages combined with mass media campaigns have also been tested and could be paired with promotions of healthier foods.<sup>347-352</sup>

Another venue for policy change to prevent childhood obesity is the after-school program (recreation centers, YMCA, Boys and Girls club). Afterschool sites may be a promising venue to reach youth, as most centers are associated with specific elementary or middle schools and offer free snack and supper programs sponsored by the USDA. Interventions and programs to prevent childhood obesity have been widely implemented in schools with encouraging results.<sup>9</sup> Furthermore, the Healthy Hunger Free Kids Act 2010 requires that all schools participating in the National School Lunch Program have a school wellness policy and to have set nutrition standards for all food sold in school.<sup>353,354</sup> However, despite the free meal program implemented in after-school settings, no local wellness policy have been created that target after-school settings. It is important that similar programs that take place in schools continue in the after-school settings to reinforce healthy messages to youth. Wellness policies that could be implemented in after-school programs include mandatory weekly nutrition education sessions, improvement of vending machine and concession stands offerings, improvement of quality of water fountains, ban of unhealthy foods from outside of the center, and ban of marketing of unhealthy foods and beverages within after-school settings. Most recreation centers managed by Baltimore City have already banned vending machines and concession stands in their facilities. However, those managed by private operators (e.g., Boys and Girls Club) still offer a wide array of candies and snacks in the center's building, which suggests an opportunity for organizational policy in these settings. Many after-school programs may consider offering foods inside the building for safety reasons and prevent children from leaving the building to acquire snacks. Thus, additional foods

offered in recreation centers could follow similar nutrition guidelines to the Smart Snacks in School regulation<sup>355</sup>, and comply with the USDA Dietary Guidelines for Americans.

In summary, public health policies that encourage stocking of healthier foods, especially in low-income settings (e.g., SNAP stocking requirements, WIC package foods, and the Staples Food Ordinance) to improve food access, accompanied with wellness policy in educational settings (i.e., schools and after-school programs) may be a promising strategy to decrease childhood obesity. Other policies to discourage consumption of unhealthy foods, including taxing unhealthy foods and utilizing the revenue in wellness programs for children should be considered. These policies would improve child well-being, decrease inequality in healthy food access and health, reduce childhood obesity prevalence, and consequently also impact medical and healthcare costs.

### 8.1 Block Kids Food Frequency Questionnaire

# What are kids eating now?

**Your name:** \_\_\_\_\_

**Today's date:** \_\_\_\_\_

**INSTRUCTIONS:**

For each food on the survey, please tell us if you ate it in the last week. Use a pencil to fill it out.

We ask two questions for each food on the survey:

- How many days last week did you eat it?**  
Mark the bubble that shows the number of days you ate the food last week. In the **EXAMPLE**, this person had **EGGS** two days last week, and **MACARONI AND CHEESE** on one day last week.
- When you ate it, how much did you have?**  
Mark the bubble that shows how much of the food you ate in one day. In this **EXAMPLE**, this person had one **EGG** each time, and a **B-size bowl of MACARONI AND CHEESE** (use the pictures for A-B-C-D).

**How many days last week?**

None	1 Day	2 Days	3 Days	4-5 Days	Every Day
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

**How much in one day?**

Just a bit	1 egg	2 eggs	3 eggs
<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>

**See pictures, How much?**

A	B	C	D
<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>

**How many eggs do you usually eat in 1 day?**

Just a bit	1 egg	2 eggs	3 eggs
<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>

**How many days last week?**

None	1 Day	2 Days	3 Days	4-5 Days	Every Day
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

**See pictures, How much?**

A	B	C	D
<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>

**How many eggs do you usually eat in 1 day?**

Just a bit	1 egg	2 eggs	3 eggs
<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>

**See pictures, How much?**

A	B	C	D
<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>

**How many eggs do you usually eat in 1 day?**

Just a bit	1 egg	2 eggs	3 eggs
<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>

**See pictures, How much?**

A	B	C	D
<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>

**How many eggs do you usually eat in 1 day?**

Just a bit	1 egg	2 eggs	3 eggs
<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>

**See pictures, How much?**

A	B	C	D
<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>

**How many eggs do you usually eat in 1 day?**

Just a bit	1 egg	2 eggs	3 eggs
<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>

**See pictures, How much?**

A	B	C	D
<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>

**How many eggs do you usually eat in 1 day?**

Just a bit	1 egg	2 eggs	3 eggs
<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>

**See pictures, How much?**

A	B	C	D
<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>

**How many eggs do you usually eat in 1 day?**

Just a bit	1 egg	2 eggs	3 eggs
<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>

**See pictures, How much?**

A	B	C	D
<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>

**How many eggs do you usually eat in 1 day?**

Just a bit	1 egg	2 eggs	3 eggs
<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>

**See pictures, How much?**

A	B	C	D
<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>

**How many eggs do you usually eat in 1 day?**

Just a bit	1 egg	2 eggs	3 eggs
<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>

**See pictures, How much?**

A	B	C	D
<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>

**How many eggs do you usually eat in 1 day?**

Think about every time you ate anything in the past week. You can tell us you didn't eat a food at all in the past week, or that you ate it one day last week, two days last week, 3-4 days, 5-6 days, or every day.

Remember what you ate at home, at school, from fast food, or from a restaurant.

	HOW MANY DAYS LAST WEEK?							HOW MUCH IN ONE DAY?			
	NONE	1 DAY	2 DAYS	3-4 DAYS	5-6 DAYS	EVERY DAY					
Pancakes, waffles, Pop Tarts	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	How many?	<input type="radio"/> 1/2	<input type="radio"/> 1	<input type="radio"/> 2	<input type="radio"/> 3
Granola bars, breakfast bars	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	How many?	<input type="radio"/> 1/2	<input type="radio"/> 1	<input type="radio"/> 2	<input type="radio"/> 3
Eggs or breakfast sandwiches like Egg McMuffins	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	How many eggs do you usually eat in 1 day?	<input type="radio"/> Just a bite	<input type="radio"/> 1 egg	<input type="radio"/> 2 eggs	<input type="radio"/> 3 eggs
Bacon or sausage	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>					
Cooked cereal like oatmeal or grits	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	See pictures. Which bowl?	<input type="radio"/> A	<input type="radio"/> B	<input type="radio"/> C	<input type="radio"/> D
Cold cereal, like Corn Flakes, Frosted Flakes or any other kind	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	See pictures. Which bowl?	<input type="radio"/> A	<input type="radio"/> B	<input type="radio"/> C	<input type="radio"/> D
When you ate cereal, which kind did you eat? (MARK THE ONE YOU ATE THE MOST OF)	<input type="radio"/> Sweet cereals like Frosted Flakes, Fruit Loops <input type="radio"/> Plain cereals like Corn Flakes, Cheerios, Rice Krispies <input type="radio"/> Fiber cereals like Raisin Bran, Shredded Wheat <input type="radio"/> Fortified cereals like Total or Product 19										
How often do you have milk on cereal?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>					
Bananas	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	How many do you usually have in 1 day?	<input type="radio"/> 1/2	<input type="radio"/> 1	<input type="radio"/> 2	<input type="radio"/> 3
Apples or pears	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	How many do you usually have in 1 day?	<input type="radio"/> 1/2	<input type="radio"/> 1	<input type="radio"/> 2	<input type="radio"/> 3
Oranges or Tangerines (Don't count juices)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	How many, in one day?	<input type="radio"/> 1/2	<input type="radio"/> 1	<input type="radio"/> 2	<input type="radio"/> 3
Strawberries or other berries	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	See pictures. How much?	<input type="radio"/> A	<input type="radio"/> B	<input type="radio"/> C	<input type="radio"/> D



Remember what you ate at home, at school, from fast food, or from a restaurant.

	HOW MANY DAYS LAST WEEK?						HOW MUCH IN ONE DAY?				
	NONE	1 DAY	2 DAYS	3-4 DAYS	5-6 DAYS	EVERY DAY	See pictures. Which bowl?	A	B	C	D
Applesauce, fruit cocktail or pineapple slices	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>		<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Any other fruit, like grapes, peaches, watermelon, cantaloupe, fruit roll-ups	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	See pictures. How much do you usually eat?	A	B	C	D
Hamburgers or cheeseburgers, at home or from a fast food restaurant	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	How much?	<input type="radio"/> 1/2	<input type="radio"/> 1	<input type="radio"/> 2	<input type="radio"/> 3
Which kind do you usually eat?	<input type="radio"/> hamburgers <input type="radio"/> cheeseburgers										
Tacos, burritos or enchiladas	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	How many?	<input type="radio"/> 1/2	<input type="radio"/> 1	<input type="radio"/> 2	<input type="radio"/> 3
Which kind of tacos, burritos, enchiladas do you usually eat?	<input type="radio"/> with meat or chicken						<input type="radio"/> without meat or chicken				
Hot Pockets, meat ball subs or Sloppy Joes	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>					
Roast beef, or steak	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	How much?	<input type="radio"/> A	<input type="radio"/> B	<input type="radio"/> C	<input type="radio"/> D
Hamburger Helper, beef and noodles, beef stew, or any other beef dishes	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	How much?	<input type="radio"/> A	<input type="radio"/> B	<input type="radio"/> C	<input type="radio"/> D
Pork chops, ribs, or cooked ham	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	How much?	<input type="radio"/> A	<input type="radio"/> B	<input type="radio"/> C	<input type="radio"/> D
Fried chicken including chicken nuggets, from home or from a restaurant like KFC	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	How many pieces?	<input type="radio"/> 1	<input type="radio"/> 2 (or 5 nuggets)	<input type="radio"/> 3	<input type="radio"/> 4
Any other kind of chicken, like roasted chicken, chicken stew, Chicken Helper	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	How much?	<input type="radio"/> A	<input type="radio"/> B	<input type="radio"/> C	<input type="radio"/> D

	HOW MANY DAYS LAST WEEK?							HOW MUCH IN ONE DAY?			
	NONE	1 DAY	2 DAYS	3-4 DAYS	5-6 DAYS	EVERY DAY		A	B	C	D
Remember what you ate at home, at school, from fast food, or from a restaurant.											
Any kind of fish, like fish sandwich, fish sticks, shrimp or tuna	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	How much?	<input type="radio"/> A	<input type="radio"/> B	<input type="radio"/> C	<input type="radio"/> D
Spaghetti, ravioli or lasagna with tomato sauce?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	How much?	<input type="radio"/> A	<input type="radio"/> B	<input type="radio"/> C	<input type="radio"/> D
Macaroni and cheese	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	How much?	<input type="radio"/> A	<input type="radio"/> B	<input type="radio"/> C	<input type="radio"/> D
Pizza or pizza pockets	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	How many slices?	<input type="radio"/> 1/2	<input type="radio"/> 1	<input type="radio"/> 2	<input type="radio"/> 3
Hot dogs or corn dogs	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	How many?	<input type="radio"/> 1/2	<input type="radio"/> 1	<input type="radio"/> 2	<input type="radio"/> 3
Lunch meat like bologna, chicken, sliced ham. Remember sandwiches and Lunchables	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	How many slices of lunch meat?	<input type="radio"/> 1/2	<input type="radio"/> 1	<input type="radio"/> 2	<input type="radio"/> 3
Refried beans	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	How much?	<input type="radio"/> A	<input type="radio"/> B	<input type="radio"/> C	<input type="radio"/> D
Vegetable soup, vegetable beef soup, or tomato soup	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	See pictures. Which bowl?	<input type="radio"/>	<input type="radio"/> B	<input type="radio"/> C	<input type="radio"/> D
Any other soup like chicken noodle, Cup-a-soup, ramen noodles, or menudo, posole	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	See pictures. Which bowl?	<input type="radio"/>	<input type="radio"/> B	<input type="radio"/> C	<input type="radio"/> D
Biscuits or muffins	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	How many?	<input type="radio"/> 1/2	<input type="radio"/> 1	<input type="radio"/> 2	<input type="radio"/> 3
Whole wheat bread or whole wheat rolls	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	How many slices in one day?	<input type="radio"/> 1	<input type="radio"/> 2	<input type="radio"/> 3-4	<input type="radio"/> 5 or more
White bread, toast or rolls, including sandwiches or bagels	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	How many slices in one day?	<input type="radio"/> 1	<input type="radio"/> 2	<input type="radio"/> 3-4	<input type="radio"/> 5 or more

PLEASE DO NOT WRITE IN THIS AREA

SERIAL #

Remember what you ate at home, at school, from fast food, or from a restaurant.

	HOW MANY DAYS LAST WEEK?							HOW MUCH IN ONE DAY?				
	NONE	1 DAY	2 DAYS	3-4 DAYS	5-6 DAYS	EVERY DAY		How many?	1	2	3-4 or more	
<b>Tortillas</b>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	How many?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>		
<b>Margarine or butter, like on bread or on pancakes or on potatoes</b>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	How many times each day?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>		
<b>Cheese. Remember cheese in sandwiches</b>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	How many slices of cheese each day?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>		
<b>Mayonnaise or sandwich spread</b>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>						
<b>Peanut butter sandwich</b>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	How many times those days?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>		
<b>Jelly or jam</b>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>						
<b>Sunflower seeds, peanuts or other nuts</b>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	How much in one day?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>		
<b>Salad with lettuce, green salad</b>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	See pictures. Which bowl?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>		
<b>Salad dressing</b>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>						
<b>Green beans, string beans or peas</b>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	See pictures. How much?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>		
<b>Pinto beans, black beans, chili with beans, or bean burritos</b>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	See pictures. How much?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>		

SERIAL #

PLEASE DO NOT WRITE IN THIS AREA

Remember what you ate at home, at school, from fast food, or from a restaurant.

	HOW MANY DAYS LAST WEEK?							HOW MUCH IN ONE DAY?			
	NONE	1 DAY	2 DAYS	3-4 DAYS	5-6 DAYS	EVERY DAY					
Corn or corn on the cob	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	See pictures. How much?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Tomatoes including on salad	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	How much?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Greens like collards, mustard greens or spinach	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	See pictures. How much?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Broccoli	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	See pictures. How much?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Carrots, carrot sticks or cooked carrots	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	See pictures. How much?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Sweet potatoes, or sweet potato pie	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	See pictures. How much?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
French fries, Tater Tots, hash browns or home fries	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	See pictures. How much?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Any other kind of potatoes, like mashed, baked or boiled	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	See pictures. How much?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Any other vegetables, like squash, cauliflower or green or red peppers	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	See pictures. How much?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Rice, including fried rice, Spanish rice, rice with beans	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	See pictures. How much?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Ketchup, salsa, or barbecue sauce	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>					

Remember what you ate at home, at school, from snack machines, at the movies, or from fast food.

	HOW MANY DAYS LAST WEEK?						How much in the whole day?	HOW MUCH IN ONE DAY?			
	NONE	1 DAY	2 DAYS	3-4 DAYS	5-6 DAYS	EVERY DAY		A	B	C	D
Snack chips like potato chips, tortilla chips, Doritos, popcorn, Bugles	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	How much in the whole day?	<input type="radio"/> A	<input type="radio"/> B	<input type="radio"/> C	<input type="radio"/> D
Crackers, including snack crackers like Cheez-Its, Ritz Bits, Goldfish	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	How much in the whole day?	<input type="radio"/> A	<input type="radio"/> B	<input type="radio"/> C	<input type="radio"/> D
Nachos with cheese	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	How much in the whole day?	<input type="radio"/> A	<input type="radio"/> B	<input type="radio"/> C	<input type="radio"/> D
Ice cream, ice cream bars or frozen yogurt	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	How much in the whole day?	<input type="radio"/> A	<input type="radio"/> B	<input type="radio"/> C	<input type="radio"/> D
Cookies	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	How many cookies?	<input type="radio"/> 1	<input type="radio"/> 2-3	<input type="radio"/> 4-5	<input type="radio"/> 6+
Donuts	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	How many donuts?	<input type="radio"/> 1/2	<input type="radio"/> 1	<input type="radio"/> 2	<input type="radio"/> 3
Cake, cupcakes, Tasty Cake, Ho-Ho's, Twinkies	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	How many pieces?	<input type="radio"/> 1/2	<input type="radio"/> 1	<input type="radio"/> 2	<input type="radio"/> 3
Pie, fruit pie, fruit crisp, cobbler	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	How many pieces?	<input type="radio"/> 1/2	<input type="radio"/> 1	<input type="radio"/> 2	<input type="radio"/> 3
Chocolate candy, like candy bars, M&Ms, Reese's, Tootsie Roll	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	How many bars?	<input type="radio"/> 1 small	<input type="radio"/> 1 medium	<input type="radio"/> 1 large	<input type="radio"/> 2 large
Any other candy (not chocolate), like Skittles, Starburst, Lifesavers, gum	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	How many packages?	<input type="radio"/> 1/4	<input type="radio"/> 1/2	<input type="radio"/> 1	<input type="radio"/> 2
Chocolate milk, hot chocolate or cocoa	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	How many glasses or cartons each day?	<input type="radio"/> 1/2	<input type="radio"/> 1	<input type="radio"/> 2	<input type="radio"/> 3
Milk (not chocolate). (Don't count milk on cereal)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	How many glasses or cartons each day?	<input type="radio"/> 1/2	<input type="radio"/> 1	<input type="radio"/> 2	<input type="radio"/> 3
What kind of milk do you usually drink?	<input type="radio"/> Whole milk <input type="radio"/> Reduced-fat (2%) milk <input type="radio"/> Low-fat (1%) milk <input type="radio"/> Non-fat milk <input type="radio"/> Lactaid milk <input type="radio"/> Don't know <input type="radio"/> Soy milk <input type="radio"/> Rice milk										

Remember what you ate at home, at school, from soda machines, at the movies, or from fast food.

Sodas like Coke, Dr. Pepper, 7-Up, Sprite, Sunkist, Orange Crush. (Don't count diet sodas)

What size soda do you usually drink?

☐ 12 ounce can  
☐ 20 ounce bottle  
☐ more than 20 ounces

Slurpees, snow cones, poppicles (not ice cream)

Hawaiian Punch, Kool-Aid, Sunny Delight, Gatorade, ice tea, Snapple

Hi-C, Tang, Tampico, Mr. Juicy, Ssips punch

Real orange juice (Don't count Sunkist or other orange sodas)

Any other real fruit juices like apple juice or grape juice. (Remember juice boxes)

#### HOW MANY DAYS LAST WEEK?

☐ NONE ☐ 1 DAY ☐ 2 DAYS ☐ 3-4 DAYS ☐ 5-6 DAYS ☐ EVERY DAY

#### HOW MUCH IN ONE DAY?

How many bottles or cans in 1 day?  
☐ 1 ☐ 2 ☐ 3-4 ☐ 5+

How many glasses in 1 day?  
☐ 1 ☐ 2 ☐ 3 ☐ 4

How many glasses or juice boxes?  
☐ 1 ☐ 2 ☐ 3 ☐ 4

How many glasses or juice boxes?  
☐ 1 ☐ 2 ☐ 3 ☐ 4

How many glasses or juice boxes?  
☐ 1 ☐ 2 ☐ 3 ☐ 4

In the past week, did you take any vitamin pills, like One-a-Day or Flintstones?

☐ No ☐ Yes  
If yes, how many days last week?  
☐ 1-2 ☐ 3-4 ☐ 5-6 ☐ 7

Are you ☐ Male ☐ Female

How old are you?

Feet  Inches

How much do you weigh?  Pounds

Are you (Mark all that apply)

- ☐ African American  
☐ White  
☐ Hispanic/Latino  
☐ Asian  
☐ American Indian, Alaska native  
☐ Other

#### OFFICE USE ONLY

TODAY'S DATE MO. DAY YR. AGE WEIGHT pounds HEIGHT ft. in.

MO.	DAY	YR.	AGE	WEIGHT	HEIGHT
01	01	01	01	01	01
02	02	02	02	02	02
03	03	03	03	03	03
04	04	04	04	04	04
05	05	05	05	05	05
06	06	06	06	06	06
07	07	07	07	07	07
08	08	08	08	08	08
09	09	09	09	09	09
10	10	10	10	10	10
11	11	11	11	11	11
12	12	12	12	12	12
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28	28	28	28	28	28
29	29	29	29	29	29
30	30	30	30	30	30
31	31	31	31	31	31
32	32	32	32	32	32
33	33	33	33	33	33
34	34	34	34	34	34
35	35	35	35	35	35
36	36	36	36	36	36
37	37	37	37	37	37
38	38	38	38	38	38
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49	49	49	49	49	49
50	50	50	50	50	50
51	51	51	51	51	51
52	52	52	52	52	52
53	53	53	53	53	53
54	54	54	54	54	54
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56	56	56	56	56	56
57	57	57	57	57	57
58	58	58	58	58	58
59	59	59	59	59	59
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61	61	61	61	61	61
62	62	62	62	62	62
63	63	63	63	63	63
64	64	64	64	64	64
65	65	65	65	65	65
66	66	66	66	66	66
67	67	67	67	67	67
68	68	68	68	68	68
69	69	69	69	69	69
70	70	70	70	70	70
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72	72	72	72	72	72
73	73	73	73	73	73
74	74	74	74	74	74
75	75	75	75	75	75
76	76	76	76	76	76
77	77	77	77	77	77
78	78	78	78	78	78
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92	92	92	92	92	92
93	93	93	93	93	93
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97	97	97	97	97	97
98	98	98	98	98	98
99	99	99	99	99	99
00	00	00	00	00	00

SERIAL #

PLEASE DO NOT WRITE IN THIS AREA



	HOW MANY DAYS LAST WEEK?							HOW MUCH IN ONE DAY?			
	None	1 Day	2 Days	3-4 Days	5-6 Days	Every Day	How much?				
Low-Sodium Ketchup	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	How much?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
								A	B	C	D
Low-Fat Mayonnaise	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	How much?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
								A	B	C	D
Low-Calorie Gatorade	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	How much?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
								A	B	C	D
Diet Soda/Pop	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	How much?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
								A	B	C	D
Bottled Water	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	How much?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
								A	B	C	D
Trail Mix	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	How much?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
								A	B	C	D
Low-fat Granola Bars	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	How much?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
								A	B	C	D
Low-fat String Cheese	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	How much?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
								A	B	C	D
Baked Utz	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	How much?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
								A	B	C	D
Popcorn	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	How much?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
								A	B	C	D

1

January 7, 2015



- BAR  
CODE  
LABEL  
HERE

**NOTIFICATION TO RESPONDENT OF ESTIMATED BURDEN**

Public reporting burden for this collection of information is estimated to average 15 minutes per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. An agency may not conduct or sponsor, and a person is not required to respond to, a collection of information unless it displays a currently valid OMB control number. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to: NIH, Project Clearance Office, 6701 Rockledge Drive, MSC 7730, Bethesda, MD 20892-7730, ATTN: PRA (0525-0450). Do not return the completed form to this address.

[illegible]

SERIAL



# INSTRUCTIONS

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

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

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

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

☐ Less than  $\frac{1}{4}$  cup  
(less than 6 ounces)
 ☐  $\frac{1}{4}$  to  $1\frac{1}{4}$  cup  
(6 to 10 ounces)
 ☐  $1\frac{1}{4}$  to 2 cups  
(10 to 16 ounces)
 ☐ More than 2 cups  
(more than 16 ounces)

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

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

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

☐ Less than 1 medium fruit
 ☐ 1 medium fruit
 ☐ 2 medium fruits
 ☐ More than 2 medium fruits  
 OR  
☐ Less than  $\frac{1}{2}$  cup
 ☐ About  $\frac{1}{2}$  cup
 ☐ About 1 cup
 ☐ More than 1 cup

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

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

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

☐ About ½ cup
 ☐ About 1 cup
 ☐ About 2 cups
 ☐ More than 2 cups

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

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

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

☐ Small order or less  
 (About 1 cup or less)
 ☐ Medium order  
 (About 1½ cups)
 ☐ Large order  
 (About 2 cups)
 ☐ Super Size order or more  
 (About 3 cups or more)

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

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

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

☐ 1 small potato or less  
 (½ cup or less)
 ☐ 1 medium potato  
 (½ to 1 cup)
 ☐ 1 large potato  
 (1 to 1½ cups)
 ☐ 2 medium potatoes or more  
 (1½ cups or more)

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

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

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

☐ Less than ½ cup
 ☐ ½ to 1 cup
 ☐ 1 to 1½ cups
 ☐ More than 1½ cups

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

**DO NOT COUNT:**

- Lettuce salads
- White potatoes
- Cooked dried beans
- Vegetables in mixtures, such as in sandwiches, omelets, casseroles, Mexican dishes, stews, stir-fry, soups, etc.
- Rice

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

☐ Never  
(Go to  
Question 8)
 ☐ 1-3  
times  
last month
 ☐ 1-2  
times  
per week
 ☐ 3-4  
times  
per week
 ☐ 5-6  
times  
per week
 ☐ 1  
time  
per day
 ☐ 2  
times  
per day
 ☐ 3  
times  
per day
 ☐ 4  
times  
per day
 ☐ 5 or more  
times  
per day

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

☐ Less than ¼ cup
 ☐ ¼ to 1 cup
 ☐ 1 to 2 cups
 ☐ More than 2 cups

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

☐ Never  
(Go to  
Question 9)
 ☐ 1-3  
times  
last month
 ☐ 1-2  
times  
per week
 ☐ 3-4  
times  
per week
 ☐ 5-6  
times  
per week
 ☐ 1  
time  
per day
 ☐ 2  
times  
per day
 ☐ 3  
times  
per day
 ☐ 4  
times  
per day
 ☐ 5 or more  
times  
per day

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

☐ About ¼ cup
 ☐ About ½ cup
 ☐ About 1 cup
 ☐ More than 1 cup

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

☐ Never  
(Go to  
Question 10)
 ☐ 1-3  
times  
last month
 ☐ 1-2  
times  
per week
 ☐ 3-4  
times  
per week
 ☐ 5-6  
times  
per week
 ☐ 1  
time  
per day
 ☐ 2  
times  
per day
 ☐ 3  
times  
per day
 ☐ 4  
times  
per day
 ☐ 5 or more  
times  
per day

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

☐ Less than 1 cup
 ☐ 1 to 2 cups
 ☐ 2 to 3 cups
 ☐ More than 3 cups

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

☐ Never
 ☐ 1-3  
times  
last month
 ☐ 1-2  
times  
per week
 ☐ 3-4  
times  
per week
 ☐ 5-6  
times  
per week
 ☐ 1  
time  
per day
 ☐ 2  
times  
per day
 ☐ 3  
times  
per day
 ☐ 4  
times  
per day
 ☐ 5 or more  
times  
per day

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



### 8.3 *Child Impact Questionnaire (CIQ)*

#### Child Impact Questionnaire (CIQ)

DATE: \_\_\_\_/\_\_\_\_/\_\_\_\_

Data Collector: \_\_\_\_\_

Rec Center Zone: \_\_\_\_\_

#### Section 1. Demographic & Contact Information

1. Respondent ID #: \_\_\_\_\_

2. Respondent Name: \_\_\_\_\_

3. Respondent Date of Birth: \_\_\_\_\_ Age: \_\_\_\_\_

4. Respondent Sex (Circle):                      M                      F

5. Respondent Race (Check all that apply):

- ☐ American Indian/Alaskan Native
- ☐ Asian
- ☐ Black or African American
- ☐ Native Hawaiian/Other Pacific Islander
- ☐ White
- ☐ Other: \_\_\_\_\_

6. Respondent Ethnic Background (Check):

- ☐ Hispanic or Latino
- ☐ Not Hispanic or Latino
- ☐ Other: \_\_\_\_\_

7. Street Address (Primary): \_\_\_\_\_

8. Street Address (Alternate): \_\_\_\_\_

9. Phone Number: #1 \_\_\_\_\_ #2 \_\_\_\_\_ #3 \_\_\_\_\_

# Type (i.e. mom's cell) #1 \_\_\_\_\_ #2 \_\_\_\_\_ #3 \_\_\_\_\_

10. Name of Caregiver: \_\_\_\_\_

11. Relationship of Caregiver to Participant:

---

12. Phone Number for Caregiver:

---

13. Email Address for Caregiver:

## INTRODUCTION

“Before we begin, I want to give you some important information about this survey.

- This survey is about the foods that you buy. This means that I will ask you questions about times when you yourself had money and used it to buy food for yourself.
- All information collected will not be shared with anyone.
- There are no right or wrong answers.
- Telling us about the foods that you buy will help out kids your age in Baltimore eat healthier, so please be as honest as you can be.
- If you can't remember or if a question seems odd, just ask me and I will explain as well as I can.
- Thank you for your help.”

**Section 2. Food Purchases**

***“First we are going to talk about times when you have bought food for the people whom you live with.” (Read each answer choice. CIRCLE ONLY ONE RESPONSE.)***

14. How do you help with food shopping for your household (your household is the people who you usually eat with)?

- a. I never shop for food for my household.
- b. I go with the main food shopper on most trips to the food store (more than 50% of trips to the food store).
- c. I go with the main food shopper on some trips to the food store (less than 50% of trips to the food store).
- d. I sometimes do the food shopping for my household without an adult.
- e. I do all or most of the food shopping for my household without an adult. f.

Other (please specify): \_\_\_\_\_



***“I’m going to ask you some questions about when you buy food for yourself. I am only interested in times when you spend money on food for yourself. [You can include foods that you might buy for others that you eat too. Please don’t include foods that others bought for you.]”***

15. Think about all the places where you bought food during the last 7 days, from last \_\_\_\_ to \_\_\_\_\_. What are the all places that you shop in each category? [If child shops at less than 3 stores in a category mark the column “I do not shop at this type of food source” in each column for which there is not a response. Where are they located? How often did you shop there in the last 7 days? If child shops in more than 3 of any type of food source mark source type and name in extra rows that follow.]

**(Read each food source)**

<b>Food Source Type &amp; Name</b>	<b>Times patronized in the last 7 days (If did not shop there,</b>	<b>Address/Store code for each food</b>	<b>Who was with you on MOST trips to this place? Circle</b>
<b>Supermarket / Grocery</b>			
1.			Family Alone    Friend Other:
2.			Family Alone    Friend Other:
3.			Family Alone    Friend Other:
<b>Corner store</b>			
1.			Family Alone    Friend Other:
2.			Family Alone    Friend Other:
3.			Family Alone    Friend Other:
<b>Convenience store (like a 7-11)</b>			
1.			Family Alone    Friend Other:
2.			Family Alone    Friend Other:
3.			Family Alone    Friend Other:
<b>Fast food restaurant/ carry-out</b>			
1.			Family Alone    Friend Other:
2.			Family Alone    Friend Other:
3.			Family Alone    Friend Other:
<b>School / rec center</b>			

1.			Family Alone	Friend Other:
2.			Family Alone	Friend Other:
3.			Family Alone	Friend Other:

Food Source Type & Name	Times patronized in the last 7 days (If did not shop there, mark as 0)	Address/Store code for each food	Who was with you on MOST trips to this place? Circle
Other (truck, arabber, drug store)			
1.			Family Alone    Friend Other:
2.			Family Alone    Friend Other:
3.			Family Alone    Friend Other:
<b>EXTRA:</b> Type and name of categories with more than three places Ex: 'Carryout' Jo's Lake			
1.			Family Alone    Friend Other:
2.			Family Alone    Friend Other:
3.			Family Alone    Friend Other:
4.			Family Alone    Friend Other:
5.			Family Alone    Friend Other:
6.			Family Alone    Friend Other:

16. Now I want to get an idea of how often you buy some foods. Please think back over the last 7 days, from last \_\_\_\_ to \_\_\_\_\_. I'm going to name some foods, and I want you to count for me the number of times **you bought** them for **yourself** in the last 7 days. [You can include foods that you might buy for others that you eat too. Please don't include foods that others bought for you.] I will also ask you where you bought them most of the time.

**(This section must be completed, even if they report not purchasing any food for themselves in previous section. To administer, read one food item, and ask how many times they bought the food in the last 7 days. Write down the # in the first column. Ask where they bought it most often, and read aloud the food sources. Put a check mark (✓) in ONE column.)**

Food item	# times purchased in the last 7 days	Where did you usually buy this food?					
		Supermarket	Convenience	Corner store	Fast Food/	School / Rec	Other (write)
<b>Beverage</b>							
Regular soda (include Grape Soda) (Brand(s):							
Diet soda (include Coke Zero, Sprite Zero, Dr. Pepper 10, Pepsi							
Fruit punch or Hugs fruit drink							
100% Fruit juice (Like Juicy Juice, Welch's)(Brand(s):							
Plain Water							
Fruit flavored water (Brand(s):							
Sugar free drink mixes (like Crystal							
Whole milk							
2% milk							
1% or skim milk							
Sports drinks (Gatorade)							
Sweetened iced tea/ Half and							
Unsweetened tea/ Diet half &							
Energy drinks (Monster, Red							
Any other drinks (Type:							

Food item	# times purchased in the last 7	Where did you usually buy this food?					
		Supermarket	Convenience Store	Corner Store	Fast Food/ Carry-Out	School/ Rec Center	Other (write place)
<b>Fruit &amp; Vegetables</b>							
Apples							
Applesauce							
Bananas							
Oranges							
Other fresh fruit (Type:							
Frozen fruit (Type:							
Canned fruit/ Fruit cups							
Dried fruit (like raisins)							
Baby carrots (with or without dip)							
Celery (with or without dip)							
Cucumber (with or without dip)							
Other fresh/frozen vegetables (Type:							
Canned vegetables							
Any other fruit or vegetables (Type:							
<b>Whole Grains/ Grocery Items</b>							
White bread							
100% Whole wheat bread							
Sugary cereal (like Froot Loops, Cap'n Crunch) Brand(s):							
Low sugar cereal (like cheerios, rice krispies) Brand(s):							
High Fiber Cereal (like Shredded wheat, bran flakes)							
Hot cereal (oatmeal, grits)							
Tuna (canned)							
Cooking spray							
Any other groceries (Type:							

Food item	# times purchased in the last 7	Where did you usually buy this food?					
		Supermarket	Convenience Store	Corner Store	Fast Food/ Carry-Out	School/ Rec Center	Other (write place)
<b>Fast Food</b>							
Hamburger or Cheeseburger							
Pizza							
Fried chicken (include Chinese fried chicken wings)							
Grilled chicken							
Fried seafood (fish, shrimp, etc.)							
Grilled seafood							
French fries or tater tots (include cheese fries)							
Fruit side dish (Type:							
Vegetable side dish (include green salad) (Type:							
Subs/sandwiches/wraps (like cheesesteaks, fried chicken or fish sandwiches) Type:							
Subs/sandwiches/wraps (sliced deli meat) Type:							
Chinese food							
Tacos/burritos/nachos/quesadilla							
Any other carry-out food (Type:							
Any other carry-out food (Type:							
Any other carry-out food (Type:							
<b>Snacks</b>							
Chips or cheese curls (Type(s): )							
Baked chips (Type(s): )							
Reduced-fat chips (like R.F. Doritos) (Brand:							
Pretzels							

Food item	# times purchased in the last 7	Where did you usually buy this food?					
		Supermarket	Convenience Store	Corner Store	Fast Food/ Carry-Out	School/ Rec Center	Other (write place)
Dried fruit, nuts or seeds (like sunflower seeds)							
Baked goods (cookies, snack cakes, donuts,							
Yogurt							
Granola bars (like Quaker)							
Chocolate candy (like snickers, hershey's,							
Other candy (like Skittles, gummy bears, life savers)							
Ice cream							
Juice popsicles							
Snow cones or snow balls							
Any other Snacks (Type _____)							

17. How much money do you usually spend when you go to the corner store or convenience store? \_\_\_\_\_dollars per visit

18. How much money do you usually spend when you go to the carry out or fast food restaurant? \_\_\_\_\_dollars per visit

### Section 3. Food Preparation Environment

***“Now I am going to ask you some questions about what kinds of food you eat at home. Think back over the past 7 days, from last \_\_ to \_\_.”***

**19.** In the past 7 days, how often did a member of your household prepare food for you?

- A. Never  
***(if never, skip to question #22)***
- B. 1 time per week
- C. 2-3 times per week
- D. 4-6 times per week
- E. 1 time per day
- F. 2 or more times per day

**20.** In the past 7 days, how often did you prepare food for yourself or others (including making yourself lunch)?

- A. Never  
***(if never, skip to question #22)***
- B. 1 time per week
- C. 2-3 times per week
- D. 4-6 times per week
- E. 1 time per day
- F. 2 or more times per day

**21.** You said that you prepared food \_\_\_\_ (read # of times from question #20). What foods did you prepare? **(Write each food item in the left column, one item per row.)** In the last 7 days, how did you prepare \_\_\_\_ **(Read each food item separately, and leave open-ended. Put a check mark (✓) in each applicable column for preparation method.)** Record anything added to the foods.

FOOD (write one item per row)	PREPARATION METHOD								
	Fried (deep or pan)	Baked (or toasted)	Micro waved	Not cooked (like cereal)	Other (specify: grilled, broiled added boiling water)	Was anything added? (write out)	Added fat (✓ )	Added sugar (✓ )	Added salt (✓)




#### **Section 4. Intentions about Foods**

***"I am going to read a statement and three food choices. Please tell me which food you would really choose to eat, given your life right now.***

**(CIRCLE ONLY ONE RESPONSE)**

22. If you wanted a snack, which would you pick?

- A. Potato chips
- B. Pretzels
- C. Yogurt

23. If you were thirsty, which would you choose for a drink?

- A. Soda
- B. Fruit-flavored water
- C. Plain Water

24. If you had to eat cereal, which would you choose?

- A. Kix
- B. Life Cereal
- C. Froot Loops

25. The next time you want an after-school snack, which would you choose?

- A. Sunflower seeds
- B. French fries
- C. Candy

26. If you had to eat at a fast food restaurant or carryout, which meal would you choose?

- A. Burger (regular or cheese)
- B. Turkey sandwich
- C. Fried chicken

27. If you had to eat a vegetable, which would you choose?

- A. Baby carrots
- B. Corn
- C. Potatoes

28. If you had to drink a fruit beverage, which would you choose?

- A. Crystal Light (sugar-free drink mix)
- B. Fruit punch (including Hugs)
- C. Fruit flavored soda (like orange or grape soda)

29. If you had to choose a fruit snack, which would you choose?

- A. Apple with caramel dip
- B. Grapes

### C. Fruit roll-up

30. If you had to put something on a sandwich, which would you choose?
- A. Mustard
  - B. Regular mayonnaise
  - C. Butter
31. If you had to drink milk, which would you choose?
- A. 1% or skim milk
  - B. 2% milk
  - C. Whole milk
32. If you had to eat a quick breakfast, what would you choose?
- A. Poptarts
  - B. None, I'd skip breakfast
  - C. Piece of fruit
33. If you were making a sandwich, what type of bread would you use?
- A. White bread
  - B. Potato bread
  - C. 100% whole wheat bread

#### **Section 5. Outcome Expectancies**

***"I'm now going to read to you some statements about food. Tell me whether the statement that I read is true, mostly true, mostly false, or false" (Do not read the "Don't know" response, but mark it if they give that answer. CIRCLE ONE RESPONSE.)***

34. I would be healthier if I ate french fries three times a week instead of eating french fries seven days a week.
- A. True
  - B. Mostly true
  - C. Mostly false
  - D. False
  - E. (Don't know)
35. I would lose weight if I drink diet soda instead of regular soda.
- A. True
  - B. Mostly true
  - C. Mostly false
  - D. False
  - E. (Don't know)

36. I am more likely to get heart disease if I eat fried chicken instead of baked chicken.

- A. True
- B. Mostly true
- C. Mostly false
- D. False
- E. (Don't know)

37. I am more likely to get high blood pressure if I eat a lot of salty foods.

- A. True
- B. Mostly true
- C. Mostly false
- D. False
- E. (Don't know)

38. I will gain weight if I eat a lot of fatty foods (like potato chips).

- A. True
- B. Mostly true
- C. Mostly false
- D. False
- E. (Don't know)

39. I would have more energy if I ate more fruits and vegetables.

- A. True
- B. Mostly true
- C. Mostly false
- D. False
- E. (Don't know)

40. I will get diabetes if I eat a lot of sugary foods (like tasty cakes and ice cream).

- A. True
- B. Mostly

true C.  
Mostly  
false D.  
False  
E. (Don't know)

41. I would have more energy to exercise or play sports if I ate more whole grains

A. True  
B.  
Mostly  
true C.  
Mostly  
false D.  
False  
E. (Don't know)

42. I would feel better if I drank more water and less soda

- A. True
- B. Mostly true
- C. Mostly false
- D. False
- E. (Don't know)

43. I would feel better if I ate more fiber

- A. True
- B. Mostly true
- C. Mostly false
- D. False
- E. (Don't know)

44. I would be less likely to gain weight if I added less butter to my food

- A. True
- B. Mostly true
- C. Mostly false
- D. False
- E. (Don't know)

#### **Section 6. Self-Efficacy**

***"I'm now going to ask you some questions about how sure you are that you can eat healthy foods. You can tell me if you know you can do it, you think you can do it, you're not sure you can do it, and you know that you can't do it. Remember***

***that I am not asking if you do these things, only how sure you are that you can do it, given your everyday life"*** (CIRCLE ONE RESPONSE.)

45. I can eat vegetables several times a day.

- A. I know I can
- B. I think I can
- C. I'm not sure I can
- D. I know I can't

46. I can reduce the amount of potato chips that I eat to only one small bag a day.

- A. I know I can
- B. I think I can
- C. I'm not sure I can
- D. I know I can't

47. I can eat a bowl of low-sugar cereal for breakfast even when I am running late for school.

- A. I know I can
- B. I think I can
- C. I'm not sure I can
- D. I know I can't



48. I can drink sugar-free drinks like Crystal Light instead of fruit punch.
- A. I know I can
  - B. I think I can
  - C. I'm not sure I can
  - D. I know I can't
49. I can choose vegetables for a snack instead of potato chips or snack cakes, if I try hard enough.
- A. I know I can
  - B. I think I can
  - C. I'm not sure I can
  - D. I know I can't
50. I can eat at least one fruit everyday outside of school (fruit eaten at school doesn't count).
- A. I know I can
  - B. I think I can
  - C. I'm not sure I can
  - D. I know I can't
51. I can ask for low-fat mayonnaise or miracle whip on my sandwich.
- A. I know I can
  - B. I think I can
  - C. I'm not sure I can
  - D. I know I can't
52. I can buy fruit to snack on at the corner store.
- A. I know I can
  - B. I think I can
  - C. I'm not sure I can
  - D. I know I can't
53. I can buy baked chips instead of regular chips at the corner store.
- A. I know I can
  - B. I think I can
  - C. I'm not sure I can
  - D. I know I can't
54. I can try healthier side dishes at the fast food restaurants like having apples or yogurt instead of fries.
- A. I know I can
  - B. I think I can
  - C. I'm not sure I can
  - D. I know I can't

55. I can talk to my parents about buying me healthy snacks.

- A. I know I can
- B. I think I can
- C. I'm not sure I can
- D. I know I can't

56. I can make a sandwich on whole wheat bread versus white bread

- A. I know I can
- B. I think I can
- C. I'm not sure I can
- D. I know I can't

### Section 7. Food Knowledge

***"Now I'm going to ask you some questions about food. Please tell me which of the three foods listed is the better answer." (Do not read the "Don't know" response option, but mark it if they give that answer. CIRCLE ONE RESPONSE.)***

#### Healthy breakfasts

57. Which breakfast cereal has less sugar?

- A. Froot Loops
- B. Rice Krispies
- C. Honey Nut Cheerios
- D. (Don't know)

58. Which breakfast has less fat?

- A. Oatmeal with fruit

- B. An omelet with  
bacon
- C.  
Pop  
arts
- D. (Don't  
know)

59. Which breakfast cereal has more fiber?

- A.  
Raisin  
Bran
- B. Lucky  
Charms
- C.  
Frosted  
Flakes
- D.  
(Don't  
know)

#### Cooking at home

60. What is the healthiest way to eat vegetables?

- A. Baby carrots with low fat dip
- B. Greens cooked with added butter
- C. Hash browned potatoes fried in a pan
- D. (Don't know)

61. What's the healthiest spread to put on a sandwich?

- A.  
Butt  
er
- B.  
Mayonnai  
se
- C.  
Musta  
rd
- D. (Don't

know) Healthy

snacks

62. Which snack has less sugar?

- A. Tasty  
cake
- B.  
Cook  
ie
- C.  
Granola  
Bar
- D. (Don't  
know)

63. Which snack has less  
salt?

- A.  
Pretze  
ls
- B. Baby  
carrots
- C.  
Hot  
Cheetos
- D.  
(Don't  
know)

64. Which potato chip has  
less fat?

- A. Regular Utz potato  
chips

- B.  
Dorit  
os
- C. Baked Utz  
chips
- D. Don't  
know

Carry-out foods

65. Which sandwich bread is healthier?

- A. 100% Whole wheat
- B. White  
bread
- C. Potato  
bread
- D. (Don't  
know)

66. Which fast food has less fat?

- A. Chinese egg roll
- B.  
Chicken  
box
- C. Turkey sub
- D. (Don't  
know)

67. Which side is lowest in fat?

- A. French fries
- B. Cooked greens
- C. Chips
- D. (Don't know)

### Healthy beverages

68. Which soda has less sugar?

- A. Grape soda
- B. Coke
- C. Coke Zero
- D. (Don't know)

69. Which drink has less sugar?

- A. Red Bull (energy drink)
- B. Everfresh (fruit-flavored water)
- C. Snapple Diet half-and-half
- D. (Don't know)

70. Which milk has less fat?

- A. Whole milk
- B. Skim milk
- C. 2% milk
- D. (Don't know)

### **Section 8: Social Support Scale for Food and Physical Activity Habits**

READ: Take a minute and think about ALL the people in your life you regularly see in the places you normally go (at home, school, rec center, church, etc.). Imagine you decided to make changes in your eating and physical activity habits. Would any of the people in your life support you or not? For each question, please tell me first, with a YES or NO, if there is someone in your life who would do that action. Then, tell me from a list of relationships (on supplement) who that person or

persons are.. You can choose ALL that apply. [Check YES or NO in Column A. Use supplement and check ALL that apply in Column B.]

QUESTION: Do you have someone in your life that _____?	YES or NO? <input checked="" type="checkbox"/> ON E	What is their relationship to you? <input checked="" type="checkbox"/> ALL THAT APPLY	Is that person _____ than you? Circle one
71.A. Talks to you about making improvements in your food and physical activity habits?	Y e s  N o	Parent	
		Grandparent	
		Brother/Sister	Old / Young /SA
		Other family:	Old / Young /SA
		Friend	Old / Young /SA
		Mentor	Old / Young /SA
		Teacher/ Coach	
		Doctor/Nurse	
		Other	Old / Young /SA

71.B. Encourages you to keep making _____ healthy choices even when you don't feel like it?	Yes  No	Parent	
		Grandparent	
		Brother/Sister	Old / Young /SA
		Other family:	Old / Young /SA
		Friend	Old / Young /SA
		Mentor	Old / Young /SA
		Teacher/ Coach	
		Doctor/Nurse	
		Other	Old / Young /SA
71.C. Shows you how to make healthy choices by setting a good example?	Ye s  N o	Parent	
		Grandparent	
		Brother/Sister	Old / Young /SA
		Other family:	Old / Young /SA
		Friend	Old / Young /SA
		Mentor	Old / Young /SA
		Teacher/ Coach	
		Doctor/Nurse	
		Other	Old / Young /SA
71.D. Praises you about _____ making changes in your diet and physical activity habits?	Yes  No	Parent	
		Grandparent	
		Brother/Sister	Old / Young /SA
		Other family:	Old / Young /SA
		Friend	Old / Young /SA
		Mentor	Old / Young /SA
		Teacher/ Coach	
		Doctor/Nurse	
		Other	Old / Young /SA
71.E. Will be your buddy with making food and	Ye s	Parent	
		Grandparent	
		Brother/Sister	Old / Young /SA
		Other family:	Old / Young /SA

physical activity changes together?	N o	Friend	Old / Young /SA
		Mentor	Old / Young /SA
		Teacher/ Coach	
		Doctor/Nurse	
		Other	Old / Young /SA
71.F. Helps you solve problems that get in the way of your eating healthy and being active?	Yes    ____ No	____ Parent	
		Grandparent	
		____ Brother/Sister	Old / Young /SA
		Other family: _____	Old / Young /SA
		____ Friend	Old / Young /SA
		____ Mentor	Old / Young /SA
		____ Teacher/ Coach	
		____ Doctor/Nurse	
		____ Other	Old / Young /SA



71.G. Tells you about new healthy foods and encourages you to try new healthy foods?	Y e s  N o	Parent	
		Grandparent	
		Brother/Sister	Old / Young /SA
		Other family:	Old / Young /SA
		Friend	Old / Young /SA
		Mentor	Old / Young /SA
		Teacher/ Coach	
		Doctor/Nurse	
		Other	Old / Young /SA

### Section 9: Social Support for Healthy and Unhealthy Eating

READ: "Now I'm going to ask you some questions about how OFTEN your parent/ guardian may do certain things related to healthy and unhealthy eating. I'll also ask you similar questions about how OFTEN your friends or other kids about your same age do certain things related to healthy and unhealthy eating. Tell me if you think these things happen never, rarely, sometimes, often, or very often."

72. Parent support for healthy eating					
How often does your parent/guardian:	Never	Rarely	Sometimes	Often	Very Often
72.a. Give you ideas on how to eat healthier foods					
72.b. Offer you low-fat snacks					
72.c. Encourage you to stay away from high-fat foods or sweets					
72.d. Talk with you about eating more healthy foods					
73. Peer support for healthy eating					

How often do your friends or someone about your age:	Never	Rarely	Sometimes	Often	Very Often
73.a. Give you ideas on how to eat healthier foods					
73.b. Offer you low-fat snacks					
73.c. Encourage you to stay away from high-fat foods or sweets					
73.d. Talk with you about eating more healthy foods					

74. Parent support for unhealthy eating					
How often does your parent/guardian:	Never	Rarely	Sometimes	Often	Very Often
74.a. Offer you high-fat foods or sweets					
75.b. Encourage you to eat high-fat foods or sweets					
75.c. Say nice things about the sweet or high-fat foods you were eating					
75. Peer support for unhealthy eating					
How often do your friends or someone about your age:	Never	Rarely	Sometimes	Often	Very Often
75.a. Offer you high-fat foods or sweets					
75.b. Encourage you to eat high-fat foods or sweets					
75.c. Say nice things about the sweet or high-fat foods you were eating					

## Section 10. Breakfast Consumption

76. In the past 7 days, how many days did you eat breakfast? (Breakfast includes a meal within 2-3 hours of waking, it does not have to be certain foods). Circle one:

- a. None
- b. One day in the last week
- c. Two days in the last week
- d. 3-4 days in the last week
- e. 5-6 days in the last week
- f. Everyday

77. What did you eat for breakfast yesterday? Record all foods and things added to foods, similar to a 24-hr recall.

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## Section 11. Anthropometry

***“Finally, we’re going to see how tall you are and how much you weigh.”***

**Height:** 1. \_\_\_/8 inches  
\_\_\_\_\_

2. \_\_\_ \_\_\_ \_\_\_/8 inches

Average of 1<sup>st</sup> 2 measurements:

\_\_\_/8 inches

**If different by more than 1/4th inch take 3<sup>rd</sup> measurement:**

3rd measurement: \_\_\_ \_\_\_ \_\_\_/8 inches

Average of all 3 measurements:

\_\_\_/8 inches

**Weight:**

1. \_\_\_ . \_\_\_ lbs

2. \_\_\_ . \_\_\_ lbs

Average of 1<sup>st</sup> 2 measurements: \_\_\_ . \_\_\_ lbs

**If different by more than 0.2 lbs take 3<sup>rd</sup> measurement:**

3. \_\_\_ . \_\_\_ lbs

**SELF-REPORTED (only in case of refusal to be measured)**

Height \_\_\_ ft. \_\_\_ in  
Weight \_\_\_ . \_\_\_ lbs

## Section 12. School and Recreation Center Program Participation

78. What is the name of your school? (If it is summer, note the name of the school attended last year):

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79. How often do you buy lunch at school in a week? \_\_\_\_\_ times/week (0-5)

80. Does your school have a salad bar that children can use? \_\_\_\_\_ Yes  
\_\_\_\_\_ No

81. How often did you use the salad bar last bar in the last week? (or the last week school was in session): \_\_\_\_\_ times/week

82. Do you or did you take PE classes at school? \_\_\_\_\_ Yes \_\_\_\_\_ No

83. # times took/take PE/week: \_\_\_\_\_

84. Do you participate in afterschool sports? \_\_\_\_\_ Yes \_\_\_\_\_ No

85. What sport(s) do/did you participate in after school?

---

86. How many hours do/did you participate in that sport(s) per week?  
\_\_\_\_\_ hours/week

87. Which recreation center did you go to in the last month? \_\_\_\_\_

88. # times went to rec center in last month: \_\_\_\_\_ times

## 8.4 Adult Impact Questionnaire (AIQ)

### B'More Healthy: Communities for Kids (BHCK) ADULT IMPACT QUESTIONNAIRE (BASELINE)

Interviewer Name: \_\_\_\_\_ Date: \_\_\_\_/\_\_\_\_/\_\_\_\_  
Interview start time: \_\_\_\_:\_\_\_\_AM/PM  
MM DD YY

Resp. Name: \_\_\_\_\_

Relationship to Child (if applicable): \_\_\_\_\_

Resp. Address: \_\_\_\_\_

Phone Numbers: #1 \_\_\_\_\_ #2 \_\_\_\_\_  
#3 \_\_\_\_\_

Email address: \_\_\_\_\_

Child Name: \_\_\_\_\_ Child ID #: \_\_\_\_\_

Signed consent obtained?: Yes ☐ No ☐

#### Interview Checklist

**"Before we begin, I want to give you some important information about this survey."**

1. This survey will take approximately 60 minutes. \_\_\_\_
2. All information collected will not be shared with anyone. \_\_\_\_
3. There are no right or wrong answers. \_\_\_\_
4. If you need any of the questions or answer choices to be repeated, please ask me and I will be happy to help you. \_\_\_\_
5. You can opt out of the survey at any time. \_\_\_\_
6. Thank you so much for your help. \_\_\_\_

**"I am going to ask you questions about the types of foods you buy and prepare for you and your child (name). I will also ask you about how you prepare foods for you and your child (name) and where you shop for foods. I will ask you how money affects the food you eat and, towards the end of the interview, I would like to get your height and weight."**

**Inclusion Criteria.** Only conduct the interview if the respondent meets the following criteria:

1. Provides signed consent form
2. Is one of the main food shoppers in the household
3. Is at least 18 years of age
4. Will live in the neighborhood for at least one year and will be available for follow-up

[NOTE: AFTER INSPECTION AND CHECKING OF FORM, REMOVE THIS TOP SHEET AND KEEP IN A SEPARATE LOCATIO

## Section 1 – Household information

1. How many people live in your household?  
\_\_\_\_\_ (Fill in the blank)
2. How many children (under 18 yrs) live in your household?  
\_\_\_\_\_ (Fill in the blank)
3. If yes, what is each child's age?  
\_\_\_\_\_ (Fill in the blank)
4. Do any of your children attend a recreation center in Baltimore?  
\_\_\_\_\_ (Fill in the blank)
5. If yes, what the name of the recreation center?  
\_\_\_\_\_ (Fill in the blank)

## Section 2 – Food source and purchasing

I am going to now read a list of locations or sources where you may have gotten food in the last 30 days. For each food source/location please tell me how many times in the last 30 days you got food there. [Refer to photographs for corner stores and carryouts]

In the last 30 DAYS, how many times did you purchase or get foods from the following locations?	# of times	Did you get <b>fresh</b> fruits or vegetables? (raw or cooked, not in sandwiches, don't include potato)		Address(es) of food source/location	
				Most often	Second most often
6. A farmer's market in Baltimore City		Yes <input type="checkbox"/>	No <input type="checkbox"/>		
7. A local or urban farm stand		Yes <input type="checkbox"/>	No <input type="checkbox"/>		
8. An Arabber or mobile produce cart		Yes <input type="checkbox"/>	No <input type="checkbox"/>		
9. Street food vendor		Yes <input type="checkbox"/>	No <input type="checkbox"/>		
10. A public market (i.e. Lexington Market)		Yes <input type="checkbox"/>	No <input type="checkbox"/>		
11. The Virtual Supermarket program		Yes <input type="checkbox"/>	No <input type="checkbox"/>		
12. A local corner store		Yes <input type="checkbox"/>	No <input type="checkbox"/>		
13. A supermarket or grocery store (include Walmart)		Yes <input type="checkbox"/>	No <input type="checkbox"/>		



14. A wholesale food store (i.e. Sam's club, BJ's, Costco)		Yes <input type="checkbox"/>	No <input type="checkbox"/>		
In the last 30 DAYS, how many times did you purchase or get foods from the following locations?	# of times	Did you buy <b>fresh</b> fruits or vegetables? (raw or cooked, not in sandwiches, don't include potato)	Address(es) of food source/location		
			Most often	Second most often	
15. A local carryout		Yes <input type="checkbox"/>	No <input type="checkbox"/>		
16. A chain fast food restaurant (McDonalds, KFC etc)		Yes <input type="checkbox"/>	No <input type="checkbox"/>		
17. A specialty store (bakery, African store, coffee shop)		Yes <input type="checkbox"/>	No <input type="checkbox"/>		
18. A sit-down restaurant, bar/pub		Yes <input type="checkbox"/>	No <input type="checkbox"/>		
19. Food pantry		Yes <input type="checkbox"/>	No <input type="checkbox"/>		
20. Church or community center		Yes <input type="checkbox"/>	No <input type="checkbox"/>		
21. Convenience stores (chain stores, i.e. Seven-Eleven, WaWa, Royal Farms, etc.)		Yes <input type="checkbox"/>	No <input type="checkbox"/>		
22. Family/friends		Yes <input type="checkbox"/>	No <input type="checkbox"/>		
23. Other, please specify _____ _____		Yes <input type="checkbox"/>	No <input type="checkbox"/>		

24. In the last 30 days, how much money did you spend in groceries for your household at a supermarket, indoor market, or wholesale club? Do not include foods that might have been purchased using food stamps, WIC, or other vouchers.

\_\_\_\_\_ Dollars

25. If you receive food stamps, how much money did you spend in the last 30 days using food stamp benefits to purchase groceries for your household?

\_\_\_\_\_ Dollars

26. If you receive WIC, how much money did you spend in the last 30 days using WIC benefits to

**purchase groceries for your household? Check all that apply under the INFANTS, CHILDREN, and WOMEN categories and sum the total estimated dollar amount.**

**INFANTS (less than 1 yr)**

- ☐ Fully Formula Fed Infant 0-3 Months (\$165.00)
- ☐ Fully Formula Fed Infant 4-5 Months (\$185.0)
- ☐ Fully Formula Fed Infant 6-11 Months (\$130.00)
- ☐ Partially Breastfed 0-1 Month (\$15.00)
- ☐ Partially Breastfed 1-3 Months (\$75.00)
- ☐ Partially Breastfed 4-5 Months (\$90.00)
- ☐ Partially Breastfed 6-11 Months (\$85.00)
- ☐ Fully Breastfed 0-5 Months (\$0.00)
- ☐ Fully Breastfed 6-11 Months (\$70.00)

**CHILDREN (1-5 yrs.)**

- ☐ Child 1-4 yrs (\$35.00)

**WOMEN**

- ☐ Partially Breastfeeding (\$50.00)
- ☐ Postpartum Non-Breastfeeding (\$35.00)
- ☐ Fully Breastfeeding (\$60.00)

\_\_\_\_\_ Dollars

- 27. In the last 30 days, how much did you spend each time you went to a carry-out or drive-thru fast food restaurant (include prepared food from convenience/corner store) for your household? (ADMINISTRATOR: refer to table above to see how many times respondent "got" food from a carry-out or drive-thru fast food restaurant. MULTIPLY this number by amount reported for EACH time getting food from a carry-out or drive-thru fast food restaurant.)**

\_\_\_\_\_ Dollars Each Time

\_\_\_\_\_ Total Dollars Spent Eating Out in Last 30 Days

- 28. In the last 30 days, how much money did you spend each time you went to a corner store or convenience store (exclude prepared food) for your household? (ADMINISTRATOR: refer to table above to see how many times respondent "got" food from a corner store or convenience store. MULTIPLY this number by amount reported for EACH time getting food from a corner store or convenience store.)**

\_\_\_\_\_ Dollars Each Time

\_\_\_\_\_ Total Dollars Spent Eating Out in Last 30 Days

- 29. In the last 30 days, how much did you spend each time you went out to eat for you and your household? (ADMINISTRATOR: refer to table above to see how many times respondent "got" food from eating out. MULTIPLY this number by amount reported for EACH time eating out.)**

\_\_\_\_\_ Dollars Each Time

\_\_\_\_\_ Total Dollars Spent Eating Out in Last 30 Days

- 30. In the last 30 days, how much total money did you spend on food for your household?**

\_\_\_\_\_ Dollars

### Section 3 - Getting of non-prepared foods for the household

Now I want to get an idea of how often you get some foods. Please think back over the last 30 days. I'm going to name some foods and I want you to tell me how often you got these foods for your household in the last 30 days/4 weeks. You may have gotten these foods by buying them, using food stamps or WIC, or receiving them for free. Do not include prepared foods from vendors, delis, carry-outs, and restaurants.

In the last 30 DAYS, how many times did you get these foods?	# of times
<b>Dairy Products</b>	-----
31. Whole Milk (or Lactaid)	
32. 2% Milk (or Lactaid)	
33. 1% or skim milk (or lactaid)	
34. Yogurt	
<b>Beverages</b>	-----
35. Regular soda or regular energy drinks	
36. Diet soda or diet energy drinks (include Coke Zero, Sprite Zero, Pepsi Next, etc.)	
37. Fruit drinks, vitamin water, sports drinks, cocktail, lemonade	
38. Water	
39. 100% Fruit Juice (Brand:_____)	
40. Sugar free drinks or drink mixes (Crystal Light, Wyler's Light)	
41. Sweetened Iced Tea/ Half and Half	
42. Unsweetened tea/ Diet Half and Half	
<b>Fruit and Vegetables</b>	-----
43. Apples	
44. Oranges	
45. Bananas	
46. Applesauce	
47. Other Fresh Fruit (Types: _____)	
48. Frozen Fruit: (Types: _____)	
49. Canned fruit (or fruit cup) in fruit juice (peaches, pears, mixed)	
50. Canned fruit (or fruit cup) in syrup (light or heavy)	
51. Fresh Vegetables (exclude regular potato) (Types: _____)	
52. Frozen Vegetables	
53. Canned Vegetables	
<b>Meats</b>	-----
54. Tuna (canned), in oil	
55. Tuna (canned), in water	

56. Hot dog, beef or pork sausage or bacon	
57. Turkey hot dog, sausage, or bacon	
58. Beans, dried or canned, no salt or sugar	
59. Baked beans, pork and beans, beans with salt added	
Cereals & Bread	-----
60. Sugary cereals (Ex. Fruit Loops, Crunch Berries, Corn Pops)	
61. Low sugar, low fiber cereals (Ex. Corn flakes, Cheerios)	
62. High fiber cereals (Ex. Bran flakes, shredded wheat, raisin bran, granola)	
63. 100% Whole wheat bread	
64. White bread or Split top wheat	
65. Hot cereal (oatmeal, grits) (plain)	
66. Hot cereal (oatmeal, grits) (sweetened)	
Snacks	-----
67. Chips (Potato chips, Doritos, Tortilla chips, Cheese curls)	
68. Pretzels	
69. Baked Chips (Type(s): _____ )	
70. Reduced-fat Chips (Like R.F. Doritos) (Brands(s): _____ )	
71. Cookie, Cake or Danish (ex. Honey bun, Tastycake)	
72. Granola Bar or cereal bar	
73. Candy (candy bars, chocolates, Skittles, Gummy bears, etc.)	
74. Ice cream, snow balls, snow cones	
75. Dried fruit, nuts, or seeds (like sun flower seeds)	
76. Juice popsicles	
Condiments & others	-----
77. Butter, margarine or shortening	
78. Oil (e.g. vegetable, olive, canola)	
79. Reduced fat butter or margarine	
80. Cooking spray	
81. Mayonnaise	
82. Lite Mayonnaise	
83. Ketchup	
84. Mustard	

#### **Section 4 – Preparation Methods**

85. In the last 30 days, how many times did you prepare a meal? It may help you to think on a week by week basis. [A meal is considered combining 2 or more food ingredients with or without using heat – e.g., cereal with milk, pasta with sauce.]

\_\_\_\_\_ Number of times

Now I will read a list of foods you may have prepared for your household in the last 30 days. For each food item, I would like to know what top 3 most common cooking methods were when it was cooked in your home. Please tell me whether you deep fry, pan fry, pan fry and rinse in hot water, cook with cooking spray, broil, grill or BBQ, steam, boil, or microwave the food.

In the last 30 days, what was the most commonly used cooking method for each of the following foods?	Deep Fried	Pan-Fried with oil	Pan-Fried, drained	Pan-fried, drained and rinsed with hot water	Use Cooking Spray	Broiled/Baked	Grilled or BBQed	Steamed	Boiled	Raw	Microwaved	Not prepared in the last 30 days
86. Chicken												
87. Pork (incl bacon)												
88. Ground beef												
89. Turkey (incl ground turkey or bacon)												
90. Eggs												
91. Greens (not lettuce)												
92. Potatoes												
93. Fish												

## Section 5 - Psychosocial Factors

### Food-Related Self-Efficacy

I am now going to list some food-related activities. I would like you to tell me how easy or difficult it would be for you to do each activity for you in your daily life, as it is right now, by choosing one of these answers: would be very easy, somewhat difficult, very difficult, or impossible to do regularly. (Check ONE response.)

94. How easy or difficult would it be for you to regularly use cooking spray (like Pam) instead of oil, shortening, or butter when preparing meals?

Very easy..... ☐

Somewhat difficult ..... ☐

Very difficult ..... ☐

Would be impossible ..... ☐

95. How easy or difficult would it be for you regularly reduce the number of times you buy carryout or fast food restaurant food for the household?

Very easy..... ☐

Somewhat difficult..... ☐

Very difficult ..... ☐

Would be impossible ..... ☐

**96. How easy or difficult would it be for you regularly use 100% whole wheat bread to make sandwiches or toast for the household?**

Very easy..... ☐

Somewhat difficult..... ☐

Very ..... ☐

Would be impossible..... ☐

**97. How easy or difficult would it be for you regularly read the nutrition facts on food labels to decide what foods to purchase for the household?**

Very easy..... ☐

Somewhat difficult..... ☐

Very difficult ..... ☐

Would be impossible..... ☐

**98. How easy or difficult would it be for you regularly buy cereals with less sugar like Cheerios for breakfast instead of high sugar cereals like Frosted Flakes, Honey Nut Cheerios for the household?**

Very easy..... ☐

Somewhat difficult..... ☐

Very difficult ..... ☐

Would be impossible ..... ☐

**99. How easy or difficult would it be for you regularly buy baked chips or pretzels instead of regular chips as a snack for the household?**

Very easy..... ☐

Somewhat difficult..... ☐

Very difficult ..... ☐

Would be impossible..... ☐

**100. How easy or difficult would it be for you regularly have fruits or vegetables as a snack (or giving them to your child as a snack)?**

Very easy ..... ☐

Somewhat difficult..... ☐

Very difficult ..... ☐

Would be impossible..... ☐

**101. How easy or difficult would it be for you regularly eat fresh, or frozen vegetables (not corn, potatoes) everyday?**

- Very easy..... ☐
- Somewhat difficult..... ☐
- Very difficult ..... ☐
- Would be impossible..... ☐

**102. How easy or difficult would it be for you regularly choose 1% or skim milk (or Lactaid) instead of 2% or whole milk (or Lactaid)?**

- Very easy ..... ☐
- Somewhat difficult..... ☐
- Very difficult ..... ☐
- Would be impossible..... ☐

**103. How easy or difficult would it be for you regularly choose water/low sugar beverage (low-calorie teas, flavored water, diet soda) instead of regular soda/tea/juice drinks?**

- Very easy..... ☐
- Somewhat difficult..... ☐
- Very difficult ..... ☐
- Would be impossible..... ☐

**Intentions about foods**

I am now going to ask you questions about how you prepare foods and how you purchase foods for you and \_\_\_\_\_ (name of child). For each question, I will give you three choices. Please tell me which one of the three options you would do. (Check ONE response.)

**104. The next time you fried eggs for the household, what would you use to fry them?**

- Cooking spray..... ☐
- Vegetable oil..... ☐
- Vegetable shortening, margarine, butter, or lard . ☐

**105. The next time you have to cook ground meat for the household, which method would you use?**

- Frying then draining and rinsing off the fat with hot water ..... ☐
- Frying in its own fat ..... ☐
- Frying in its own fat and also drain ..... ☐

**106. The next time you buy fries from a carryout restaurant, which would you choose?**

- Medium..... ☐
- Large ..... ☐
- Small ..... ☐

**107. The next time you buy cereal, which would you choose?**

- Cheerios ..... ☐
- Frosted Flakes..... ☐
- Cap'n Crunch..... ☐

**108. The next time you buy milk, which would you choose (include Lactaid)?**

Regular, whole milk ..... ☐

2% milk ..... ☐

1% or skim milk ..... ☐

**109. The next time you want to buy a salty snack, which would you choose?**

Regular Potato chips ..... ☐

Baked chips ..... ☐

Pretzels ..... ☐

**110. The next time you want to buy a sweet snack, which would you choose?**

Donut ..... ☐

Granola bar ..... ☐

Tasty cake ..... ☐

**111. The next time you buy a drink for the household at a grocery or convenient store, which would you choose?**

Sugar free drink mix (like Crystal Light) ..... ☐

Fruit punch ..... ☐

Fruit -flavored soda ..... ☐

**112. The next time you are thirsty, which would you choose?**

Regular soda ..... ☐

Lite or diet beverage ..... ☐

Water ..... ☐

**113. The next time you buy bread at the store, which kind would you buy?**

White Bread ..... ☐

Split Top Wheat bread ..... ☐

100% Whole wheat/grain bread ..... ☐

### **Food-Related Knowledge**

**I am going to ask you more questions about food preparation and food purchasing. For each question, please pick the answer that you think answers the question best. If you are not sure of the answer, just give me your best guess. (Do not read answer choice D. Only mark it if respondent explicitly states that he/she does not know. Please be sure that this survey is not in view of the respondent for this reason.)**

**114. Which of the following adds the least amount of fat?**

Vegetable oil ..... ☐

Shortening ..... ☐

Cooking spray ..... ☐

Don't know ..... ☐



**115. Which of the following do you think is a low-fat option to choose from a carry-out menu?**

- Burger with French fries ..... ☐
- Chef Salad with Blue Cheese dressing ..... ☐
- Grilled chicken with baked potato ..... ☐
- Don't know..... ☐

**116. Which cereal do you think has more fiber?**

- Raisin Bran..... ☐
- Corn flakes ..... ☐
- Kix ..... ☐
- Don't know..... ☐

**115. Which milk (or Lactaid) is lowest in fat?**

- Whole milk..... ☐
- Skim milk or 1% milk ..... ☐
- 2% Milk ..... ☐
- Don't know..... ☐

**116. Which of the following drinks has the least amount of calories?**

- Crystal Light..... ☐
- Regular Pepsi..... ☐
- 100% Juice ..... ☐
- Don't know..... ☐

**117. Which of the following drinks is 100% juice?**

- Sunny Delight ..... ☐
- Juicy Juice..... ☐
- Fruit Punch ..... ☐
- Don't know..... ☐

**118. Which of the following has the least amount of sugar?**

- Pears in fruit juice ..... ☐
- Pears in light syrup ..... ☐
- Fresh sliced pears ..... ☐
- Don't know..... ☐

**119. Which of the following side dishes has the least amount of fat?**

- French Fries ..... ☐
- Potato salad (with mayo) ... ☐

<b>Nutrition Facts</b>	Amount/serving	%DV*	Amount/serving	%DV
Serv. Size 1 cup (249g)	<b>Total Fat</b> 12g	<b>18%</b>	<b>Sodium</b> 940mg	<b>39%</b>
Servings About 2	Sat. Fat 6g	<b>30%</b>	<b>Total Carb.</b> 24g	<b>8%</b>
<b>Calories</b> 250	Polyunsat. Fat 1.5g		Dietary Fiber 1g	<b>4%</b>
Fat Cal. 110	Monounsatur. Fat 2.5g		Sugars 1g	
*Percent Daily Values (DV) are based on a 2,000 calorie diet.	<b>Cholest.</b> 60mg	<b>20%</b>	<b>Protein</b> 10g	<b>20%</b>
Vitamin A 0% • Vitamin C 0% • Calcium 6% • Iron 8%				
<b>INGREDIENTS:</b> WATER, CHICKEN STOCK, ENRICHED PASTA (SEMOLINA WHEAT FLOUR, EGG WHITE SOLIDS, NIACIN, IRON, THIAMINE MONONITRATE [VITAMIN B1], RIBOFLAVIN [VITAMIN B2] AND FOLIC ACID), CREAM (DERIVED FROM MILK), CHICKEN, CONTAINS LESS THAN 2% OF: CHEESES (GRANULAR, PARMESAN AND ROMANO PASTE (PASTEURIZED COW'S MILK, CULTURES, SALT, ENZYMES), WATER, SALT, LACTIC ACID, CITRIC ACID AND DISODIUM PHOSPHATE), BUTTER (PASTEURIZED SWEET CREAM [DERIVED FROM MILK] AND SALT), MODIFIED CORN STARCH, SALT, WHOLE EGG SOLIDS, SUGAR, DATEM, RICE STARCH, GARLIC, SPICE, XANTHAN GUM, CHEESE FLAVOR (PARTIALLY HYDROGENATED SOYBEAN OIL, FLAVORINGS AND SMOKE FLAVORING), MUSTARD FLOUR, ISOLATED SOY PROTEIN AND SODIUM PHOSPHATE.				

Canned beans n' pork ☐

Don't know ☐

**Nutrition label reading (Write DK for don't know)**

120. How many calories are in each serving? \_\_\_\_\_

121. How many grams of fat are in **each** serving? \_\_\_\_\_

122. How many grams of fat are in the **entire** package? \_\_\_\_\_

## Section 6. Health Beliefs and Attitudes

I am going to read you some statements. I'd like you to tell me how strongly you agree or disagree with each statement by choosing one of the following responses [Refer to answer sheet]: strongly disagree, disagree, undecided, agree or strongly agree. Remember that this is not a test. There are no right answers to these questions. I just want to know what you think.

Healthy Foods	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
123. Healthy foods are expensive.					
124. Making a healthy dinner takes too much time.					
125. Preparing and eating healthy foods is important to me.					
126. I don't buy healthy foods at corner stores because they are not available.					
127. I cannot afford to eat healthy foods.					
128. Healthy foods are tasteless.					
129. Making a healthy dinner for my family is expensive.					
130. Healthy foods are not convenient to make.					
131. I think a lot about what I eat.					
132. Healthy foods are important for my child's health.					

Body Image and Health	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
133. I am satisfied with my weight.					
134. I am satisfied with the way my body looks.					
135. I am content with my child's weight.					

#### Section 7 – Food Assistance Participation

In the past 12 months, since (this month) 2012, did you or anyone in your household receive any of the following? (Check Yes or No for each program.)

Program Type	Receive? Yes/No (Check ONE answer per program)	
136. WIC	Yes <input type="checkbox"/>	No <input type="checkbox"/>
137. SNAP benefits	Yes <input type="checkbox"/>	No <input type="checkbox"/>
138. Free or reduced cost school breakfast	Yes <input type="checkbox"/>	No <input type="checkbox"/>
139. Free or reduced cost school lunch	Yes <input type="checkbox"/>	No <input type="checkbox"/>
140. Head Start or daycare assistance	Yes <input type="checkbox"/>	No <input type="checkbox"/>
141. Other (Specify)		

141. If you received SNAP benefits in the last 6 months, on what day of the month did you usually receive your food benefits? \_\_\_\_\_

#### Section 8– Demographics and Contact Information

142. What is your Date of Birth?

\_\_\_\_/\_\_\_\_/\_\_\_\_  
MM DD YY

143. Sex:

Male..... ☐

Female.... ☐

144. What is your race/ethnicity?

American Indian/Alaskan Native..... ☐

Asian..... ☐

Black or African American..... ☐

Native Hawaiian/Other Pacific Islander..... ☐

White..... ☐

Other..... ☐

145. What is your ethnicity?

Hispanic or Latino..... ☐

Not Hispanic or Latino..... ☐

Other.....☐

**146. What is your current marital status? (Check ONE response.)**

Never married ..... ☐

Married..... ☐

Separated ..... ☐

Divorced..... ☐

Widowed ..... ☐

Decline to answer ..... ☐

**147. What is the highest degree or level of school you completed? (Check ONE response.)**

Less than 6<sup>th</sup> grade ☐

6<sup>th</sup> grade ..... ☐

7<sup>th</sup> grade..... ☐

8<sup>th</sup> grade..... ☐

9<sup>th</sup> grade ..... ☐

10<sup>th</sup> grade..... ☐

11<sup>th</sup> grade ..... ☐

High school (12<sup>th</sup> grade)... ☐

GED ..... ☐

<2 yrs college..... ☐

Associate's degree..... ☐

Bachelor's degree ..... ☐

Graduate school..... ☐

Vocational school..... ☐

Other ..... ☐

If Other, specify: \_\_\_\_\_

**148. Are you currently employed? (Check ONE response.)**

Yes ..... ☐

No ..... ☐

Retired ..... ☐

Disabled ..... ☐

Other..... ☐

If Other, specify: \_\_\_\_\_

**149. If yes to Question 53, what is your employment status? (Check only ONE response.)**

Full-time ..... ☐

Part-time ..... ☐

Seasonal/occasional ..... ☐

Student ..... ☐

Unemployed – looking for work ..... ☐

Unemployed ..... ☐

Other ..... ☐

If Other, specify: \_\_\_\_\_

**150. In which range is your annual household income? (show card and ask them to point)**

0-10,000..... ☐

10,001-20,000..... ☐

20,001-30,000..... ☐

30,001-40,000..... ☐

40,001-50,000..... ☐

50,001-60,000..... ☐

60,001-70,000..... ☐

70,001-80,000..... ☐

80,001+..... ☐

Declined to answer... ☐

**151. What is your current housing arrangement?**

Own property..... ☐

Rent..... ☐

Live with family who own the property.... ☐

Live with family who rent property ..... ☐

Transitional housing..... ☐

Shelter ..... ☐

Group House..... ☐

Other: \_\_\_\_\_ . ☐

### Section 9 – Food security

Now I'm going to read you several statements that people have made about their food situation. For these statements, please tell me whether the statement was often true, sometimes true, or never true for (you/your household) in the last 12 months—that is, since last (name of current month).

#### **Household Stage 1: Questions 152-154**

152. (I/We) worried whether (my/our) food would run out before (I/we) got money to buy more." Was that often true, sometimes true, or never true for (you/your household) in the last 12 months?

- ☐ Often true
- ☐ Sometimes true
- ☐ Never true
- ☐ DK or Refused

153. "The food that (I/we) bought just didn't last, and (I/we) didn't have money to get more." Was that often, sometimes, or never true for (you/your household) in the last 12 months?

- ☐ Often true
- ☐ Sometimes true
- ☐ Never true
- ☐ DK or Refused

154. "(I/we) couldn't afford to eat balanced meals." Was that often, sometimes, or never true for (you/your household) in the last 12 months?

- ☐ Often true
- ☐ Sometimes true
- ☐ Never true
- ☐ DK or Refused

**Screener for Stage 2 Adult-Referenced Questions:** If affirmative response (i.e., "often true" or "sometimes true") to one or more of Questions 152-154, then continue to ***Adult Stage 2***; otherwise, if children under age 18 are present in the household, skip to ***Child Stage 1***, otherwise skip to ***End of Food Security Module***.

#### **Adult Stage 2: Questions 155-159** (asked of households passing the screener for Stage 2 adult-referenced questions).

155. In the last 12 months, since last (name of current month), did (you/you or other adults in your household) ever cut the size of your meals or skip meals because there wasn't enough money for food?

- ☐ Yes
- ☐ No
- ☐ DK

156. [IF YES ABOVE, ASK] How often did this happen—almost every month, some months but not every month, or in only 1 or 2 months?

- ☐ Almost every month
- ☐ Some months but not every month
- ☐ Only 1 or 2 months
- ☐ DK

157. In the last 12 months, did you ever eat less than you felt you should because there wasn't enough money for food?

- ☐ Yes
- ☐ No
- ☐ DK

158. In the last 12 months, were you every hungry but didn't eat because there wasn't enough money for food?

- ☐ Yes
- ☐ No
- ☐ DK

159. In the last 12 months, did you lose weight because there wasn't enough money for food?

- ☐ Yes
- ☐ No
- ☐ DK

**Screener for Stage 3 Adult-Referenced Questions:** If affirmative response to one or more of questions 155-159 continue to ***Adult Stage 3***; otherwise, if children under age 18 are present in the household, skip to ***Child Stage 1***, otherwise skip to ***End of Food Security Module***.

**Adult Stage 3: Questions 160-161** (asked of households passing screener for Stage 3 adult-referenced questions).

160. In the last 12 months, did (you/you or other adults in your household) ever not eat for a whole day because there wasn't enough money for food?

- ☐ Yes
- ☐ No
- ☐ DK

161. [IF YES ABOVE, ASK] How often did this happen—almost every month, some months but not every month, or in only 1 or 2 months?

- ☐ Almost every month
- ☐ Some months but not every month
- ☐ Only 1 or 2 months
- ☐ DK

**Child Stage 1: Questions 162- 164:** Households with no child under age 18, skip to ***End of Food Security Module***.

Now I'm going to read you several statements that people have made about the food situation of their children. For these statements, please tell me whether the statement was OFTEN true, SOMETIMES true, or NEVER true in the last 12 months for (your child/children living in the household who are under 18 years old).

162. "(I/we) relied on only a few kinds of low-cost food to feed (my/our) child/the children) because (I was/we were) running out of money to buy food." Was that often, sometimes, or never true for (you/your household) in the last 12 months?

- ☐ Often true
- ☐ Sometimes true
- ☐ Never true
- ☐ DK or Refused

163. "(I/We) couldn't feed (my/our) child/the children) a balanced meal, because (I/we) couldn't afford that." Was that often, sometimes, or never true for (you/your household) in the last 12 months?

- ☐ Often true
- ☐ Sometimes true
- ☐ Never true
- ☐ DK or Refused

164. "(My/Our child was/The children were) not eating enough because (I/we) just couldn't afford enough food." Was that often, sometimes, or never true for (you/your household) in the last 12 months?

- ☐ Often true
- ☐ Sometimes true
- ☐ Never true
- ☐ DK or Refused

**Screener for Stage 2 Child Referenced Questions:** If affirmative response (i.e., "often true" or "sometimes true") to one or more of questions 162-164, then continue to ***Child Stage 2;*** otherwise skip to ***End of Food Security Module.***

**Child Stage 2: Questions 165-169** (asked of households passing the screener for stage 2 child-referenced questions).

165. In the last 12 months, since (current month) of last year, did you ever cut the size of (your child's/any of the children's) meals because there wasn't enough money for food?

- ☐ Yes
- ☐ No
- ☐ DK

166. In the last 12 months, did (CHILD'S NAME/any of the children) ever skip meals because there wasn't enough money for food?

- ☐ Yes
- ☐ No
- ☐ DK

167. [IF YES ABOVE ASK] How often did this happen—almost every month, some months but not every month, or in only 1 or 2 months?



- ☐ Almost every month
- ☐ Some months but not every month
- ☐ Only 1 or 2 months
- ☐ DK

168. In the last 12 months, (was your child/were the children) ever hungry but you just couldn't afford more food?

- ☐ Yes
- ☐ No
- ☐ DK

169. In the last 12 months, did (your child/any of the children) ever not eat for a whole day because there wasn't enough money for food?

- ☐ Yes
- ☐ No
- ☐ DK

#### Section 10 - Anthropometry

##### Height

170. Permitted height measurement? \_\_\_\_ yes \_\_\_\_ no

171. Self-reported height (if declined) \_\_\_\_ feet \_\_\_\_ inches \_\_\_\_ Don't know

172. Measured height: \_\_\_\_ feet \_\_\_\_ inches or \_\_\_\_ /8 inches (without shoes) 1<sup>st</sup>  
 Measured height: \_\_\_\_ feet \_\_\_\_ inches or \_\_\_\_ /8 inches (without shoes)  
 2nd

If more than .25 inches off measure a 3<sup>rd</sup> time

Measured height: \_\_\_\_ feet \_\_\_\_ inches or \_\_\_\_ /8 inches (without shoes)  
 3rd

##### Weight

173. Permitted weight measurement? \_\_\_\_ yes \_\_\_\_ no

174. Clothing:

- \_\_\_\_ light (like t-shirt, shorts)
- \_\_\_\_ medium (like shirt, pants, socks)
- \_\_\_\_ heavy (like shirt, pants, socks, sweater, shoes, etc.)

175. \_\_\_\_ . \_\_\_\_ pounds

\_\_\_\_ . \_\_\_\_ pounds (If measurement is off .5 pounds or more, measure a third time)

\_\_\_\_ . \_\_\_\_ pounds

176. Self-reported weight (if declined measurement): \_\_\_\_ . \_\_\_\_ pounds

### Section 11-Medical History

In this section, I will ask you about your family and personal medical history. [Check ONE answer per condition.]

177. Has a doctor or nurse ever told →	You that you have...	A blood relative that they have...
a. Overweight or obesity	Yes _____ No _____ Don't Know _____	Yes _____ No _____ Don't Know _____
b. Heart disease	Yes _____ No _____ Don't Know _____	Yes _____ No _____ Don't Know _____
c. High Blood Pressure	Yes _____ No _____ Don't Know _____	Yes _____ No _____ Don't Know _____
d. Type 2 Diabetes	Yes _____ No _____ Don't Know _____	Yes _____ No _____ Don't Know _____
e. Cancer	Yes _____ No _____ Don't Know _____	Yes _____ No _____ Don't Know _____

## 8.5 Intervention Exposure Questionnaire (IEQ)

### B'more Healthy Communities for Kids Intervention Exposure Evaluation Form-Wave 2

Date: \_\_\_\_/\_\_\_\_/\_\_\_\_ Data collector: \_\_\_\_\_  
MM DD YY

Check one: Caregiver interview \_\_\_\_\_ Child interview \_\_\_\_\_

Resp. Name: \_\_\_\_\_ Resp. ID#: \_\_\_\_\_  
(First) (Last)

I'm going to ask you about or show you some pictures of materials that **MIGHT** have been in **SOME local stores and recreation centers.**

#### 1. B'more Healthy Communities for Kids Logo

a. Have you heard about the B'more Healthy Communities for Kids (BHCK) program?

\_\_\_\_ Yes \_\_\_\_ No \_\_\_\_ Maybe

b. Have you seen this logo before? (**SHOW the packet p.1**)

\_\_\_\_ Yes  
\_\_\_\_ No  
\_\_\_\_ Maybe

c. In how many different places (stores, rec centers, carryouts, social media, wholesaler, community events) have you seen this logo?

\_\_\_\_ None \_\_\_\_ 1-2 places \_\_\_\_ 3-5 places \_\_\_\_ 6 or more places

(Don't count: grocery stores, buses, metro stops, billboards or anywhere we have not posted the BHCK logo) Show participant **PG 2-9** with images of the stores.

#### 2. Shelf Labels (**SHOW the packet p.9**)

a. Have you seen any of the B'more Healthy Communities for Kids shelf labels like these in corner stores?

\_\_\_\_ Yes  
\_\_\_\_ No  
\_\_\_\_ Maybe

b. In how many different corner stores or carryouts have you seen these shelf labels?

\_\_\_\_ None \_\_\_\_ 1-2 stores \_\_\_\_ 3-5 stores \_\_\_\_ 6 or more stores

c. How often have you purchased a food **SPECIFICALLY** because you saw a B'more Healthy Communities for Kids shelf label with it?

\_\_\_\_ Always or almost always  
\_\_\_\_ Often

- ☐ Sometimes  
☐ Rarely  
☐ Never

d.If you ever saw a shelf label, which of the following foods did you EVER buy in the last year **BECAUSE** you saw a B'more Healthy Communities for Kids shelf label like the ones I just showed you under it? (mark 1=yes, 0=no)

**DID NOT SEE SHELF LABELS**

- ☐ Water  
☐ Diet/sugar free soda (Coke Zero, Diet Pepsi, Sprite Zero, Diet Sunkist, etc.)  
☐ Crystal Light packets  
☐ Higher in fiber cereals (like oatmeal, Raisin Bran, Wheaties, etc.)  
☐ Lower sugar cereals (like Cheerios, Kix, Chex, Rice Krispies, Corn Flakes etc.)  
☐ 1% milk  
☐ Skim milk  
☐ Split Top Wheat Bread  
☐ Whole Milk  
☐ Cooking spray  
☐ 100% Whole wheat bread  
☐ Whole Wheat Tortillas  
☐ Low fat string cheese  
☐ Low fat yogurt  
☐ Low fat condiments (miracle whip, low-fat mayo, ketchup, mustard)  
☐ Baked chips  
☐ Pretzels  
☐ Lowfat granola bar  
☐ Nuts/seeds/trail mix  
☐ Fruits (apple, banana, tangerine, raisins, canned fruit in 100% juice)  
☐ Vegetables (fresh, canned, or frozen)  
☐ Other
- 

**3. Taste Tests and Cooking Demonstrations**

The B'more Healthy Communities for Kids has done a number of taste tests and cooking demonstrations in stores and rec centers over the past year. Which of the following have you participated in or seen in person?

\*Cooking demonstrations only apply to child interviews

<b>3.a. Taste Tests:</b>	<b>Yes</b>	<b>No</b>	<b>Maybe</b>
Hugs			
Sugar-free drink mix (Crystal Light)			
Diet soda (Coke or Pepsi Zero)			
Low-fat String Cheese			
Low-fat granola bars			

<b>3.a. Taste Tests:</b>	<b>Yes</b>	<b>No</b>	<b>Maybe</b>
Tangerines			
Baked Chips			
Baby carrots			
Low sugar cereal (Cheerios, Chex, Kixs)			
100% whole wheat toast with peanut butter			
Whole Wheat Quesadillas			
Low-fat, Low sugar Cake			
Whole wheat chips and tomato salsa			

<b>3.b. Cooking Demonstrations (Skip for AIQ):</b>	<b>Yes</b>	<b>No</b>	<b>Maybe</b>
Veggie Omelets			
Baked chicken (Crispy Chicken nuggets)			
Ramen Noodles			
Healthy Veggie Pizza			
Quesadillas and home made salsa			

**3.c. Did you attend the cooking event at Rita Church Recreation Center on Saturday June 4<sup>th</sup> from 1:30pm to 4:00m? ((SHOW the packet p.10)**

☐ Yes  
☐ No  
☐ Maybe

**4. Posters (SHOW the packet p.11-13)**

The B'more Communities for Kids Project put up many posters in stores, carryouts and recreation centers. Which of the following have you seen and/or read?

<b>Posters</b>	<b>Yes</b>	<b>No</b>	<b>Maybe</b>
"Refresh with sugar free soda"			
" Step up your water"			
" Hungry for a sweet snack?"			
"Fruits are fine to snack-on any time!"			
"Look to the wisdom of our ancestors"			
"Reach your potential with whole grains"			
"Reach your potential with smart cooking"			
"Look for the leaf."			
"Try a fresh side or drink."			
"Make it a combo meal."			
"Try a combo Meal at Halal Foods"			

**5. Handouts (SHOW the packet p. 14-18)**

The B'more Healthy Communities for Kids project has distributed multiple handouts. Which of the following have you received and/or read?

<b>Handouts:</b>	<b>Yes</b>	<b>No</b>	<b>Maybe</b>
Refuel with these tips for smart snacking			
High Energy Noodles Recipe			
OPREVENT Approved Healthy Snacks			
Stoplight snacks			
Refuel with Smart Snacks			
Why choose whole grain?			
Reach your potential with 100% whole grains!			
Rethink your drink; water has zero calories			
Watch out for sugar!			

### **6. Giveaways (SHOW the packet p. 19-22)**

The B'more Healthy Communities for Kids project distributed gifts at participating stores and recreation centers. Which of the following did you or anyone in your household receive?

<b>Giveaways:</b>	<b>Yes</b>	<b>No</b>	<b>Maybe</b>
Water Bottle			
Drawstring Bags			
Grape and Orange Stress Balls			
Apple Pens			
Chip Clips			
Re-usable grocery bags			
Jar openers			
Portion Plates			
Lanyards			
Portion Bowl			
Sunglasses			
Sandwich container			
Logo magnet			
Coin Purse			
Pen			
Pencil			
Measuring Spoon			
Sticky notes			

### **7. Educational activities**

The B'more Healthy Communities for Kids Project did some educational activities with displays in corner stores and recreation centers. Which of the following displays have you seen or participated in? (**SHOW the packet p. 23-25**)

<b>Educational Activities</b>	<b>Yes</b>	<b>No</b>	<b>Maybe</b>
Rethink your drink			
Lower Fat Cooking Display			
Healthier Desserts			
Have a craving for chips?			
Rethink Your Veggies			
Rethink Your Bread			

### 8. Carryout menus

We also developed some new menus in carryout restaurants. Have you seen any of our new menus in carryout stores? **(SHOW the packet p. 26-32)**

<b>Menu name</b>	<b>Yes</b>	<b>No</b>	<b>Maybe</b>
Halal Foods			
T&M Carryout			
Spencer's Carryout			
Banana House Carryout			
Kings Mini Mart (L&T Mini Mart)			
Saints Deli			
WWW Pizza			
3 Bears Carryout			
Sunnyside Café			

- a. How many times did you buy a promoted side dish ( a green leaf item that was low in fat and calories labeled with a green leaf logo) in the past 7 days? \_\_\_\_\_ times
- b. Was it because you saw the green leaf logo/promotional poster?  
\_\_\_\_\_ Yes      \_\_\_\_\_ No      \_\_\_\_\_ Maybe      \_\_\_\_\_ n/a
- c. How many times did you buy a promoted menu item (a green leaf item that was low in fat and calories labeled with a green leaf logo) ? \_\_\_\_\_ times
- d. Was it because you saw the leaf logo?  
\_\_\_\_\_ Yes      \_\_\_\_\_ No      \_\_\_\_\_ Maybe      \_\_\_\_\_ n/a
- e. How many times did you buy a healthy combo meal (a green leaf item that was low in fat and calories labeled with a green leaf logo as a side and entrée and a low sugar drink) ? \_\_\_\_\_ times
- f. Was it because you saw the leaf logo/promotional poster?

\_\_\_ Yes      \_\_\_ No      \_\_\_ Maybe      \_\_\_ n/a

### 9. Participating Stores

Below is a list of stores that participated in the B'more Healthy Communities for Kids Project. Please tell me how many times you bought something from each store in the past 7 days (**SHOW the packet p. 2-9**)

Store name and Location:	# times in past 7 days
Corner Mini Mart (526 Oldham Street)	
Corona Grocery (3520 E Lombard St)	
T&M Carryout (3812 E Lombard St)	
<b>CECIL KIRK</b>	
Barclay Food Market (2701 Barclay Street)	
Green Mart & Deli (445 E 25th St)	
Banana House Carryout (441 E 25th St)	
<b>CARMELO ANTHONY</b>	
Sun's Grocery (400 Pitman Place)	
AJ Mini Mart (2039 Jefferson St)	
Sunny Side Café (2420 E Monument St)	
<b>JD GROSS</b>	
Halal Foods (4202 Park Heights Ave)	
Slaters Market (5125 Park Heights Ave)	
Dash Convenient Mart (5110 Park Heights Ave)	
<b>TOWANDA</b>	
Convenience Store (4101 Reisterstown Rd)	
WWW Pizza (3020 Liberty Heights Ave)	
Saints Deli (3942 Park Heights Ave)	
<b>DEWEES</b>	
4744 Corner Store (4744 Alhambra Rd.)	
Family Food Market (5413 York Rd, Baltimore)	
David's Market (841 Belgian Ave)	
<b>RITA CHURCH</b>	
Kings Mini Mart (L&T Mini Mart) (1861 N. Collington Ave)	
Fenwick Food Mart (2749 Fenwick Ave)	



<b>Store name and Location:</b>	<b># times in past 7 days</b>
Spencer's Carryout (2446 E Preston St.)	

### 10. Rec center activities (Skip for AIQ)

The B'more Healthy Communities for Kids Project included activities taught by BHCK youth-leaders in some rec centers such as jeopardy, button making, bowling, UOENO video, cooking classes, etc. There were 14 B'more Healthy lessons with games, activities and cooking classes from November 2015 to June 2016. **(SHOW Packet p.34-35)**

a. How many of these sessions do you think you attended? \_\_\_\_\_ sessions

b. Did you attend any of these recreation centers during the 2015-2016 after school program?

Recreation Center	Yes	No
Cecil Kirk		
Carmelo Anthony		
J. D. Gross		
Towanda		
DeWees		
Rita Church		
Carroll F. Cook		

If yes, how often on average did you go to one of the above rec centers during the 2015-2016 after-school program?	Never	
	Less than 1 time per month (1-11 times a year)	
	1-3 times per month	
	1-2 times a week	
	3 or more times a week	

c. During 5 weeks, we a BHCK youth-leader held phone calls, text messages, and in-person meetings with some youth in the community. Did you participate in the BHCK summer peer-mentoring program in July 2015? **(SHOW Packet pg. 35)**

\_\_\_ Yes                      \_\_\_ No                      \_\_\_ Maybe

In the last year (2015-2016) how many times did a BHCK youth leader talk to you about healthy eating at your rec center or through text-message (SMS), at your home, corner store, or a park ? (Youth Leaders were young people who are close to your age and worked for our program.) <b>(SHOW the packet p. 36-37)</b>	Never	
	1- 5 times	
	6-10 times	
	10+ times	

**11. Social Media Activities (SHOW the packet p. 38-45)**

a. Have you ever received a BHCK text (SMS) message? \_\_\_\_\_ (Y/N) **(Skip for CIQ)**

How many times per week did you receive a text message about the BHCK program?  
 \_\_\_\_\_ **(Skip for CIQ) (pg. 38)**

b. Do you follow/like the BHCK Facebook page (bhck1)? \_\_\_\_\_ (pg. 39)

Do you follow/like our Instagram site (bmore4kids)? \_\_\_\_\_ (pg. 40)

Have you seen the following social media posts? (pg 41-45)

<b>Social Media Post</b>	<b>Yes</b>	<b>No</b>
For this week's #SpotlightSaturdayBHCK, we are featuring Saint's Deli		
#ThrowbackThursday to the BHCK Cooking Event at Rita Church Rec		
Check out our #video Choose What you Chew		

<b>Social Media Post</b>	<b>Yes</b>	<b>No</b>
Now is the time to break up with Sugar!		
#DidYouKnow Hugs fruit drinks contain less sugar than soda?		
#Bmore4Kids works with Baltimore's carryout restaurants...		
@Bmore4Kids Summer Snacks Challenge		
The 3 phase diet to fix your metabolism		

e. From April – July we have been doing some mailings. The letters were sent in neon colored envelopes with a nutrition flyer, educational handout, invitation to an event/postcard and an occasional giveaway (i.e. coin purse, pencil, pen, magnet etc.) (See pg. 46-47): Have you received a letter/ envelope from BHCK? \_\_\_\_\_ (Y/N)f. How frequently did you receive a BHCK letter?

\_\_\_\_\_ 1 x per week  
 \_\_\_\_\_ 2 x per month  
 \_\_\_\_\_ 1 x per month

g. How many total envelopes have you received?

\_\_\_\_\_ total envelopes

## 8.6 Exposure Packet

### Posters



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**David's Market:** [841 Belgian Ave]



**Rita Church:**

**Kings Mini Mart:** [1861 N. Collington Ave]



**Fenwick Food Market:** [2749 Fenwick Ave]



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**Saints Deli:** [3942 Park Heights Ave]



**DeWees:**

**4744 Corner Store:** [4744 Alhambra Rd.]



**Family Food Market:** [5413 York Rd, Baltimore]



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**Dash Convenience Mart:** (5110 Park Heights Ave)



**Towanda:**  
**Convenience Store:** (4101 Reisterstown Rd)



**WWW Pizza:** (3020 Liberty Heights Ave)



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**Sunny Side Café:** (2420 E Monument St)



**JD Gross:**  
**Halal Foods:** (4202 Park Heights Ave)



**Slaters Market:** (5125 Park Heights Ave)



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**Banana House Carryout:** (441 E 25th St)



**Carmelo Anthony:**

**Sun's Grocery:** (400 Pitman Place)



**AJ Mini Mart:** (2039 Jefferson St)



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**T&M Carryout:** (3812 E Lombard St)



**Cecil Kirk:**

**Barclay Food Market:** (2701 Barclay Street)



**Green Mart and Deli:** (445 E 25th St)



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## Store Fronts

**Carroll Cook:**

**Corner Mini Mart:** (526 Oakham Street)



**Corona Grocery:** (3520 E Lombard St)



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**Spencer's Carryout:** (2446 E Preston St.)



## Shelf Talkers



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## 8.7 Supplemental Table S4.1 for Chapter 4

**Table S4. 1:** Sensitivity analysis of caregiver's correlates of level of exposure to the B'more Healthy Communities for Kids trial using quadratic model for linear regression<sup>a</sup>

Determinants of Exposure to BHCK Caregiver and Household	Bivariate Analysis		Final Multiple Model <sup>b</sup>	
	Coefficient (robust SE)	95% CI	Coefficient (robust SE)	95% CI
Sex (Reference: Male)	0.17 (0.11)	(-0.05; 0.39)	0.18 (0.11)	(-0.03; 0.41)
Age (years)	-0.01 (0.01)	(-0.01; 0.01)		
Education Level				
< High School	Reference			
High School	0.02 (0.08)	(-0.15; 0.20)		
> High School	-0.03 (0.08)	(-0.19; 0.13)		
Individuals in the household	0.01 (0.02)	(-0.03; 0.04)		
Household Annual Income (US\$)				
0-10,000	Reference			
10,001-20,000	-0.12 (0.08)	(-0.28; 0.04)		
20,001-30,000	-0.07 (0.09)	(-0.25; 0.11)		
>30,000	0.01 (0.07)	(-0.14; 0.15)		
Food Assistance Participation				
SNAP (Reference: non-SNAP)	-0.06 (0.07)	(-0.18; 0.07)	-0.03 (0.06)	(-0.16; 0.09)
WIC (Reference: non-WIC)	-0.01 (0.07)	(-0.16; 0.12)		
Housing Arrangement				
Living w/ family <sup>c</sup> or other <sup>d</sup>	Reference		Reference	
Rented	-0.02 (0.09)	(-0.21; 0.16)	-0.04 (0.09)	(-0.24; 0.16)
Owned	0.09 (0.11)	(-0.11; 0.31)	0.07 (0.11)	(-0.14; 0.30)

Notes: SE: robust standard error; CI: confidence interval; SNAP (Supplemental Nutrition Assistance Program); WIC (Special Supplemental Nutrition Program for Women, Infants, and Children)

<sup>a</sup> Ordered logistic regression on overall BHCK exposure level (quartiles) among youth

<sup>b</sup> Final model selected based on goodness of best fit using stepwise backward regression for lowest Akaike information criterion (AIC): 1185.1

<sup>c</sup> Living with family who own or rent the house

<sup>d</sup> Other included: transitional housing or group house

## 8.8 Supplemental Table S4.2 for Chapter 4

**Table S4. 2:** Sensitivity Analysis of Youth's correlates of level of exposure to the B'more Healthy Communities for Kids trial using Quadratic Model for Linear Regression<sup>a</sup>

Determinants of Exposure to BHCK Youth	Bivariate Analysis		Final Multiple Model <sup>b</sup>	
	Coefficient (robust SE)	95% CI	Coefficient (robust SE)	95% CI
Sex (Reference: Male)	-0.09 (0.06)	(-0.22; 0.03)	-0.08 (0.06)	(-0.21; 0.04)
Age (years)	-0.09 (0.02)	(-0.13; -0.05)*	-0.09 (0.02)	(-0.13; -0.04)*
Caregiver Education Level				
< High School	Reference			
High School	0.06 (0.09)	(-0.12; 0.25)		
> High School	0.09 (0.09)	(-0.09; 0.27)		
Individuals in the household	-0.02 (0.02)	(-0.06; 0.02)		
Household Annual Income (US\$)				
0-10,000	Reference			
10,001-20,000	0.07 (0.08)	(-0.11; 0.24)	0.02 (0.09)	(-0.15; 0.20)
20,001-30,000	0.16 (0.09)	(-0.03; 0.36)	0.10 (0.09)	(-0.09; 0.30)
>30,000	0.17 (0.08)	(0.01; 0.33)*	0.11 (0.08)	(-0.05; 0.26)
Food Assistance Participation				
SNAP (Reference: non-SNAP)	-0.06 (0.07)	(-0.20; 0.07)		
WIC (Reference: non-WIC)	0.05 (0.08)	(-0.09; 0.20)		
Housing Arrangement				
Living w/ family <sup>c</sup> or other <sup>d</sup>	Reference			
Rented	0.12 (0.10)	(-0.08; 0.32)		
Owned	0.17 (0.11)	(-0.05; 0.40)		

Notes: SE: robust standard error; CI: confidence interval; SNAP (Supplemental Nutrition Assistance Program); WIC (Special Supplemental Nutrition Program for Women, Infants, and Children)

<sup>a</sup> Ordered Logistic Regression on overall BHCK exposure level (quartiles) among youth

<sup>b</sup> Final model selected based on goodness of best fit using stepwise backward regression for lowest Akaike information criterion (AIC): 707.3

<sup>c</sup> Living with family who own or rent the house

<sup>d</sup> Other included: transitional housing or group house.

## 8.9 Supplemental Table S6.1 for Chapter 6

**Table S6. 1:** Completed-case impact analysis **not using** inverse probability weighted method

Caregiver Fruit and Vegetable Behaviors	Baseline				Post-intervention				Pre-post change: difference <sup>c</sup>	p
	Intervention		Comparison		Intervention		Comparison			
	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Effect (95% CI)	
<b>Acquisition</b> (frequency/day) <sup>c</sup>										
Healthful food score	1.52	0.07	1.47	0.07	1.40	0.07	1.41	0.07	-0.06 (-0.25; 0.12)	0.49
Unhealthful food score	1.27	0.07	1.31	0.07	1.21	0.07	1.29	0.07	-0.03 (-0.25; 0.19)	0.77
<b>Home meal preparation</b>										
Frequency of meal preparation	35.32	2.08	34.27	2.02	33.24	2.03	38.30	2.08	-4.02 (-10.9; 2.90)	0.25
Healthful cooking score	-0.08	0.06	-0.14	0.06	-0.01	0.06	-0.08	0.06	0.01 (-0.22; 0.22)	0.92
<b>Daily Consumption</b> (srv/day) <sup>d</sup>										
Fruits	1.21	0.16	1.59	0.18	1.24	0.12	1.21	0.13	0.41 (-0.15; 0.97)	0.15
Vegetables	1.36	0.10	1.59	0.11	1.10	0.07	1.38	0.08	-0.04 (-0.36; 0.27)	0.77
Fruit and vegetable	2.69	0.23	3.20	0.25	2.35	0.18	2.59	0.18	0.28 (-0.38; 0.94)	0.41

Abbreviations: SE (standard error); CI (confidence interval); srv (servings)

<sup>a</sup> Multilevel models were conducted with Stata 13.1 package with the maximum likelihood option (**complete-case analysis** n=376 for purchasing and n=188 for consumption).

<sup>b</sup> In all models: treatment group was coded as comparison (0) and intervention (1); time was coded as baseline (0) and post-intervention (1);

standard errors were corrected for clustering for repeated measures from the same individual and BHCK neighborhood (from 1 to 30).

<sup>c</sup> Mean adjusted difference in change over time for intervention compared to control adult caregiver

<sup>d</sup> Fruit and Vegetable intakes were estimated via the Quick Fruit and Vegetable Screener from the National Cancer Institute's Eating at America's Table Study (EATS) study.

<sup>e</sup> Fruit and vegetable acquisition frequency (daily) was estimated via a pre-defined list containing 100% fruit juice, apples, bananas, oranges, other fresh fruits, frozen fruits, canned fruits, fresh vegetables, frozen vegetables, and canned vegetables (excluding potatoes and including beans). Adults reported frequency of purchasing these items in the previous 30

### 8.10 Supplemental Table S6.2 for Chapter 6

**Table S6. 2:** Difference of differences in mean change in food-related behaviors comparing BHCK level of exposure by wave 1 (reference) and wave 2 participants.

Change in food-related behaviors <sup>a,b,c</sup>	Overall BHCK Exposure Score		
	Mean Effect Modifier	SE	95% C.I.
Healthful food acquisition score (daily frequency)	0.07	0.08	-0.10; 0.25
Unhealthful food acquisition score (daily frequency)	-0.05	0.13	-0.31; 0.21
Frequency of home food preparation (days)	-3.68	3.14	-10.11; 2.73
Healthful cooking methods score	-0.07	0.11	-0.30; 0.15

Abbreviations: SE (standard error); CI (confidence interval)

<sup>a</sup> Change from pre- to post-intervention evaluation, n=370. Difference in change in fruit and vegetable intake by exposure level and wave was not possible to be calculated given that NCI FV screener was not employed among wave 1 participants at baseline.

<sup>b</sup> Multiple linear regression models clustered by BHCK zone, controlled for adult caregiver's age, sex, income, and household size. Interaction term between exposure score and wave

<sup>c</sup> Wave 1 = reference

<sup>d</sup> Communication material score mean: 0.6 (observed range: 0-3.1); <sup>e</sup> Food environment intervention exposure score mean: 0.3 (observed range: 0-3.1); <sup>f</sup> Social media/texting exposure score mean: 0.2 (observed range: 0-2); <sup>g</sup> Texting exposure score mean: 1.1 (observed range 0-3)

### 8.11 Supplemental Table S6.3 for Chapter 6

**Table S6. 3:** Proportion of variability explained (effect sizes) after fitting multivariate linear and logistic regression models on the correlation between social media exposure score and the change in food-related behaviors and fruit and vegetable intake

Change in food-related behaviors and fruit and vegetable intake (continuous) <sup>a,b</sup>	Social Media Exposure Score (continuous) <sup>f</sup>		Change in food-related behaviors and fruit and vegetable intake (Negative/No change versus Positive) <sup>a,c</sup>	Social Media Exposure Score (Low vs High) <sup>f</sup>		
	Mean	Omega-Squared <sup>d</sup>		OR	SE	95% C.I.
Healthful food acquisition score (daily frequency)	0.28	0.04	Healthful food acquisition score	1.12	0.15	0.85; 1.47
Unhealthful food acquisition score (daily frequency)	0.47*	0.005	Unhealthful food acquisition score	1.23	0.14	0.97; 1.55
Frequency of home food preparation (days)	1.41	0	Frequency of home food preparation	0.97	0.12	0.76; 1.24
Healthful cooking methods score	-0.37	0.0008	Healthful cooking methods score	0.96	0.12	0.75; 1.23
Daily total fruit consumption (servings) <sup>c</sup>	3.16*	0.04	Daily total fruit consumption <sup>c</sup>	1.25	0.19	0.93; 1.69
Daily total vegetable consumption (servings) <sup>c</sup>	-0.21	0.005	Daily total vegetable consumption <sup>c</sup>	0.97	0.12	0.76; 1.24
Daily total fruit and vegetable consumption (servings) <sup>c</sup>	2.94*	0.02	Daily total fruit and vegetable consumption <sup>c</sup>	1.10	0.10	0.91; 1.34

Abbreviation: SE, bootstrapped standard error; OR, odds ratio (standardized effect size); CI, bias corrected confidence interval

<sup>a</sup> Change from pre- to post-intervention evaluation, n=370

<sup>b</sup> Multiple linear regression models with bootstrap variance (2000 replications) and clustered by BHCK zone, controlled for adult caregiver's age, sex, income, and household size

<sup>c</sup> Fruit and Vegetable intakes were estimated via the Quick Fruit and Vegetable Screener from the National Cancer Institute's Eating at America's Table Study (EATS) study. Sample size (n) = 184

<sup>d</sup> Omega-squared ( $\omega^2$ ) estimates the proportion of the variance in the outcome which is due to the variance in the social media exposure score

<sup>e</sup> change in the outcome was categorized as 0 if no change or negative change, 1= if positive change regressed on social media score (0=low; 1=high) controlled for adult caregiver's age, sex, income, and household size.

<sup>f</sup> Social media/texting exposure score mean: 0.2 (observed range: 0-2); Low = 0 and High >0.01

\* Statistically significant behavioral change at  $p < 0.05$

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## Curriculum Vitae

Date of birth: 06/25/1988

Location of birth: São Paulo, Brazil

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## EDUCATION

September 2018

**Doctor of Philosophy (Ph.D.),** Department of International Health, Center for Human Nutrition, Johns Hopkins Bloomberg School of Public Health, Baltimore, MD, USA.

**Dissertation:** Impact of the B'more Healthy Communities for Kids (BHCK) Trial on Diet and Food-related Behaviors among Low-Income Urban African-American Youth and Adults (Dr. Joel Gittelsohn)

August 2013

**Master of Science (M.S.),** Nutrition and Public Health, Nutrition Science Program, Sao Paulo School of Medicine, Federal University of Sao Paulo, SP, Brazil.

**MS Thesis:** The influence of individual and environmental factors on physical activity level of mothers with children under 10 years of age living in Santos, SP, Brazil. (Dr. Paula A. Martins)

December 2010

**Bachelor of Science (B.S.),** Nutrition Science and Dietetics, Federal University of Sao Paulo, SP, Brazil.

**Senior Thesis:** Correlation between Physical Activity of Women and their Children under 10 years of age from Santos City, SP, Brazil (Dr. Paula A. Martins)

## SCHOLARSHIPS

2014-2018

Doctoral Fellowship from the Brazilian Science without Borders to attend the PhD program at the Johns Hopkins Bloomberg School of Public Health (48 months)



2017	The Elsa Orent Keiles Fellowship in Human Nutrition in International Health
2016	The Harry J. Prebluda Fellowship in Nutritional Biochemistry
2012	Visiting Scholar Fellowship from the Sao Paulo State Foundation for Research for an international internship research at the John Hopkins University (Oct 2012 – March 2013)
2011	Master Fellowship from the São Paulo State Foundation for Research at Federal University of Sao Paulo (Sep 2011 – Sept 2013)
2009	Undergraduate Fellowship from the Sao Paulo State Foundation for Research for Undergraduate research at Federal University of Sao Paulo (March 2009 – Dec 2010)

## RESEARCH SUPPORT

2015-2016	Northeast Regional Nutrition Education Center of Excellence (USDA) Title: <i>Sustaining a Successful Youth-Leader Program as part of a Food Environment/Behavioral Intervention</i> Role: Co-Principal Investigator
2014-2015	Urban Health Institute, Small Grant for Research and Program Development Title: <i>Formative Research to Sustain the Youth-Leader Program in Baltimore Recreation Centers</i> Role: Principal Investigator

## PROFESSIONAL TRAINING

2016-2018	Preparing Future Faculty Certificate Program, Teaching Academy, Johns Hopkins University
2012	Non-parametrical Statistical Analysis Training. Department of Biostatistics, University of Sao Paulo
2011	Nutrition and Urban Health Certificate, Institute of Health and Society, Federal University of Sao Paulo

## RESEARCH AND PROFESSIONAL EXPERIENCE

Jan 2018 – Present	<b>Research Assistant</b> , Center for Human Nutrition, International Health Department, Johns Hopkins University, Baltimore, MD.
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*OPREVENT2: Engaging Tribal Policy Makers to Improve the Food and Physical Activity Environments in American Indian Communities* (PI: Dr. Joel Gittelsohn)

- Coordinated data management and analysis of dietary, behavior, and health outcomes of 600 Native American adults
- Preparation of materials for publication and presentations of study implementation and findings.
- The project is funded by the National Heart, Lung, and Blood Institute, National Institute of Health under award R01HL122150.

Jan 2018 – Present

**Research Assistant**, Global Obesity Prevention Center, Center for Adolescent Health, Johns Hopkins University, Baltimore, MD.

*An Agent-Based Model of a Low-Income Urban Population and Food System to Inform Obesity Policies* (PI: Dr. Joel Gittelsohn)

- Coordinated additional data collection and analysis on the food behaviors and environment at the household, school, food sources, and recreation center levels for revisions of an agent-based model of Baltimore city adolescents interacting with the food environment.
- Developed a systems dynamics model in support of a proposed Staple Foods Ordinance for Baltimore City with an interdisciplinary team in collaboration with Dr. Tak Igusa (JHU Professor of Engineering) and Holly Freishtat (Baltimore Food Policy Director).
- The project is funded by the Nutrition & Obesity Network Policy Research Evaluation (NOPREN), Center for Disease Control and Prevention (1U48DP000040, SIP 14-027).

Aug 2014 – Dec 2017

**Senior Research Analyst**, Global Obesity Prevention Center, Johns Hopkins University, Baltimore, MD.

*B'more Healthy Communities for Kids (BHCK)* (PI: Dr. Joel Gittelsohn)

- Coordinated and evaluated the youth-leader nutrition education program in Baltimore recreation centers.
- Trained and supervised a staff of 10 graduate research assistants.
- Trained and supervised 18 Baltimore college and high school students on the delivery of nutrition and cooking classes in 14 Baltimore recreation centers.
- Supervised primary data collection of 230 youth and caregivers.

- Conducted data collection on the healthy store intervention, promoted healthy food in Baltimore's corner stores.
- Developed intervention communication materials.
- Led data analysis, preparation of manuscripts for publication in peer-reviewed international journals, presentation and dissemination of results in scientific meetings.
- The project was supported by the *Eunice Kennedy Shriver National Institute of Child Health and Human Development* (NICHD) and the Office of the Director, National Institutes of Health (OD) under award number U54HD070725.

Jan 2017 – Dec 2017

**Research Assistant**, Center for Human Nutrition, International Health Department, Johns Hopkins University, Baltimore, MD.

*Identifying Optimal Behavioral Economic Strategies to Increase WIC Redemptions by Low-Income Women in Baltimore Corner Stores* (PI: Dr. Gittelsohn)

- Assisted with the design, implementation, and evaluation of the program.
- Led data analysis and drafted materials for publication and presentations of the study findings.
- The study was supported by the Duke-UNC USDA BECR Center.

Jun 2015 – Dec 2016

**Co-Principal Investigator**, Global Obesity Prevention Center, Johns Hopkins University, Baltimore, MD.

*Sustaining a Successful Youth-Leader Program as part of a Food Environment/Behavioral Intervention* (Co-PIs: **Angela Trude**, Lisa Lachenmayr, Joel Gittelsohn)

- Designed, implemented, and evaluated a peer-led nutrition program as part of the BHCK intervention trial.
- Created and maintained on-going partnerships with community stakeholders
- Successfully secured funding from the Northeast Regional Nutrition Education Center of Excellence (USDA) to sustain the intervention in Baltimore City Recreation Centers, in partnership with SNAP-Ed.

May – Sept 2015

**Research Assistant**, Prisma Research, Iquitos, Peru.

*The Malnutrition and Enteric Disease Study* (PI: Dr. Margaret Kosek)

- Collected and analyzed dietary intake and anthropometry data of 350 families living in a rural area in Iquitos, Peru during June and July.

- Acquired data on Peruvian foods and updated the *El Libro Regional*, an important tool used by the data collectors in the setting when conducting 24 hours recall.
- This project is supported by the Bill & Melinda Gates Foundation, the Foundation for the National Institutes of Health, and the National Institutes of Health, Fogarty International Center.

Dec 2014 - Dec 2015

**Principal Investigator**, Global Obesity Prevention Center, Johns Hopkins University, Baltimore, MD.

*Formative Research to Sustain the Youth-Leader Program in Baltimore Recreation Centers* (PI: **Angela Trude**)

- Worked in collaboration with the Baltimore City Department of Recreation and Park (BCRP) to conduct formative research to permit planning of a BCRP staff-training program designed to sustain the implementation of the nutrition curriculum in recreation centers
- Utilized these assessments to inform and propose an action plan geared toward large-scale implementation of the BHCK nutrition curriculum program.
- This formative work was funded by the Johns Hopkins Urban Health Institute.

2011- 2013

**Research Assistant**, Institute of Health and Society, Federal University of Sao Paulo, Santos, SP, Brazil

*Assessment of the Nutrition Environment of the City of Santos, SP, Brazil* (PI: Dr. Paula A. Martins)

- Conducted master's dissertation research on the influence of the built environment on physical activity level of women from Santos.
- Developed the walkability score for Santos city.
- Prepared database and analyzed data; preparation of manuscripts for publication in peer-reviewed international journals.
- Project supported by Brazilian National Council for Scientific and Technological Development

2012-2013

**Visiting Scholar**, Center for Human Nutrition, Johns Hopkins University, Baltimore, MD.

*Healthy Stores Projects* (PI: Dr. Joel Gittelsohn)

- Collaborated in four nutrition environmental intervention programs.
- Collected and analyzed data (Stata software) on the American Indian project.

- Developed communication material for the interventions; promoted healthier foods inside Baltimore’s corner stores and American Indian Trials’ stores.
- 2010-2011      **Nutritionist**, Primary Health Care, Municipal Health Department of Santos, SP, Brazil.
- Developed nutrition education and healthy eating orientation for elderly, pregnant women and infants under two years old.
  - Led training of the Community Health Agents of the Primary Health Care Unit on the evaluation of nutritional status of pregnant women.
  - Implemented and coordinated the first “pregnant weekly support group” in the health care unit in the waiting room with an interdisciplinary team.
- 2010-2011      **Nutritionist**, Santos Tennis Club, Santos, SP, Brazil.
- Designed individualized meal plans to promote optimal performance during tennis training and tournament.
  - Orientated healthy eating in team-group workshops; measured and evaluated body composition of the youth athletes; implemented the protocol to evaluate the body dehydration rate.
- 2008-2010      **Research Assistant**, Institute for Health and Society, Santos, SP, Brazil.
- Assessment of the Nutrition Environment of the City of Santos, SP, Brazil* (PI: Dr. Paula A. Martins)
- Coordinated the development and the implementation of the adult and youth physical activity assessment questionnaire.
  - Conducted household interviews; collected data on eating and physical activity behaviors among 538 mothers and their children under 10 years old.
  - Managed and analyzed data on physical activity behavior, and prepared manuscripts.
  - Project supported by Brazilian National Council for Scientific and Technological Development
- 2008-2009      **Field Researcher**, Federal University of Sao Paulo, Santos, SP, Brazil.
- Effects of Pre-Game Sports on Life Quality of Elderly Obese Women from Santos* (Dr. Ricardo Guerra)

- Collected dietary data and analyzed food consumption behavior and dietary intake among elderly obese women.
- Project supported by Brazilian National Council for Scientific and Technological Development

## TEACHING EXPERIENCE

2017 **Instructor**, *Public Health Nutrition in Latin America* (AS.280.434), Public Health Studies Program, Johns Hopkins University, Baltimore, MD.  
<http://krieger.jhu.edu/publichealth/academics/courses/>

### Invited Lectures

2018 **Guest Lecturer**, *Improving Healthy Food Availability and Consumption among Low-Income Families in Baltimore City*  
 Course: Health and Wellbeing in Baltimore (Dr. Philip Leaf), Johns Hopkins University

2018 **Guest Lecturer**, *Individual-level Factors and Child Feeding Practices*  
 Course: Food, Culture, and Nutrition (Dr. Joel Gittelsohn), Johns Hopkins University

2017 **Guest Lecturer**, *Determinants of Diabetes and Cardiovascular Disease among Latin Americans in the U.S.*  
 Course: Latino Health Course (Dr. Julia Lechuga), in the Health, Medicine, and Society Program, Lehigh University

2015 – 2018 **Teaching Assistant**, Human Nutrition Program, Department of International Health, Johns Hopkins Bloomberg School of Public Health, Baltimore, MD

#### **Course title:** Food, Culture and Nutrition

- Developed course materials in conjunction with instructor, lectured two sessions on child and infant feeding, held office hours, maintained course website, scheduled guest lectures, facilitated labs, graded assignments, 2 terms (Dr. Joel Gittelsohn)

#### **Course title:** Principles of Human Nutrition in Public Health

- Developed course materials in conjunction with instructor, communicated with students, maintained course website, graded assignments and exams, 1 term (Dr. Kristen Hurley)

#### **Course title:** Designing Healthy Diets

- Developed course materials in conjunction with instructor, communicated with students, led the intercultural food panel, led lab sessions, graded assignments, 2 terms (Dr. Laura Caulfield)

## **PROFESSIONAL ACTIVITIES**

2014 – Present	American Society of Nutrition (ASN), member
2017 – Present	The Obesity Society (TOS), member
2010– 2014	Brazilian Society of Public Health Nutrition (ABRASCO), member

## **EDITORIAL ACTIVITIES**

1. Journal of Urban Health
2. Public Health Nutrition
3. International Journal of Health Policy and Management
4. Health Promotion Practice
5. Ecology of Food and Nutrition
6. PLOS One
7. Appetite
8. Nutrition and Health

## **HONORS AND AWARDS**

2018	Selected as the Invited Doctoral Student Speaker at the International Society of Behavioral Nutrition and Physical Activity (ISBNPA) Annual Meeting
2018	DSM-Johns Hopkins University Travel Scholarship
2018	George G. Graham Professorship Endowment
2017	Travel Award for Community and Public Health Nutrition, ASN
2017	George G. Graham Professorship Endowment
2016 America”	The Gordis Teaching Fellowship: “Public Health Nutrition in Latin
2016	Harry D. Kruse Publication Award in Human Nutrition
2016	George G. Graham Professorship Endowment
2015	Center for Global Health, Research Placement in Peru, Iquitos

## PUBLICATIONS

### Journal Articles

#### *Published/In Press*

1. **Trude ACB**, Cremm EC, Oliveira MA, Martins PA. Physical Activity and Nutritional Status of Mothers with Children under 10 years old residents of an urban area in Santos, Brazil. Nutrire: Rev. Soc. Bras. Alim. Nutr. 2013;38(3): 291-305
2. Kharmats A, Cheah YS, Jones-Smith JC, Budd N, Flamm L, Cuccia A, Mui Y, **Trude ACB**, Gittelsohn J. Relationship between the SNAP cycle and dietary quality among low-income African Americans in Baltimore, Maryland. The American Journal of Clinical Nutrition. 2014; 99(5):1006-14. doi: 10.3945/ajcn.113.075994.
3. **Trude ACB**, Kharmats A, Lee K, Martins PA, Liu D, Jock B, Pardilla M, Swartz J, Gittelsohn J. Patterns of Food Consumption are Associated with Obesity, Self-Reported Diabetes and Cardiovascular Disease in Five American Indian Communities. Ecology of Food and Nutrition. 2015; 54(5):437-54. doi:10.1080/03670244.2014.922070
4. Vedovato GM, **Trude ACB**, Kharmats A, Gittelsohn J, Martins PA. Food Buying Preferences, Perceived Food Environment and Household Patterns of Food Acquisition Based on the Degree of Food Processing in a Brazilian Urban Area. Appetite. 2015. doi:10.1016/j.appet.2014.12.229
5. Gittelsohn J, **Trude ACB**. Environmental Interventions for Obesity and Chronic Disease Prevention. J Nutr Sci Vitaminology. 2015; 61(1):S15-S16. doi: 10.3177/jnsv.61.S15
6. Han E, Jones-Smith JC, Surkan PJ, Kharmats AY, Vedovato GM, **Trude ACB**, Anderson Steeves E, Gittelsohn J. Low-income African American adults share weight status, food-related psychosocial factors and behaviors with their children. Obesity Science & Practice. 2015; 1(2); 78–87. doi:10.1002/osp4.10
7. Vedovato GM, Surkan PJ, Jones-Smith J, Steeves EA, Han E, **Trude ACB**, Kharmats AY, Gittelsohn J. Food insecurity, overweight and obesity among low-income African-American families in Baltimore City: Associations with food-related perceptions. Public Health Nutrition. 2016; 19(8):1405-16.
8. Sato P, Anderson Steeves E, Cheskin L, Carnell S, **Trude ACB**, Shipley C, Mejia Ruiz MJ, Gittelsohn J. Youth mentor-led nutritional intervention in urban Recreation Centers: A promising strategy for childhood obesity prevention in



low-income neighborhoods. Health Education Research. 2016; 31(2):195-206. doi:10.1093/her/cyw011

9. **Trude ACB**, Vedovato GM, Mui Y, Oliveira MA, Martins PA. Factors associated with physical inactivity and sedentary behavior among women living in an urban Brazilian area. Brazilian Journal of Physical Activity & Health (RBAFS). 2016; 21(2) 162-171. doi: 10.12820/rbafs.v.21n2p162-171
10. Sato P, Lourenço BH, **Trude ACB**, Unsain RF, Pereira PR, Martins PA, Scagliusi FB. Family commensality and eating practices among mothers in Santos, Brazil: a population-based study. Appetite. 2016; 1(103):38-44.
11. **Trude ACB**, Kharmats AY, Hurley KM, Anderson Steeves E, Talegawkar SA, Gittelsohn J. Household, psychosocial, and individual-level factors associated with fruit, vegetable, and fiber intake among low-income urban African American youth. BMC Public Health. 2016;16(1):1-10.
12. Kim M, Budd N, Batorsky B, Krubiner C, Manchikanti S, Waldrop G, **Trude ACB**, Gittelsohn J. Barriers and Facilitators to Stocking Healthy Food Options: Viewpoints of Baltimore City Small Storeowners. Ecology of Food and Nutrition. 2016; 14:1-14. doi: 10.1080/03670244.2016.1246361
13. Gittelsohn J, **Trude ACB**. Diabetes and Obesity Prevention: Changing the Food Environment in Low Income Settings. Nutrition Reviews. 2017; 75(S1):62–69. doi: 10.1093/nutrit/nuw038
14. Schwendler T, Shipley C, Budd N, **Trude ACB**, Surkan PJ, Anderson Steeves E, Sato PM, Eckmann T, Loh H, Gittelsohn J. Development and implementation: B'More Healthy Communities for Kid's store and wholesaler intervention. Health Promotion Practice. 2017; 18(6):822-832.
15. Gittelsohn J, **Trude ACB**, Kim H. Pricing Incentive and Disincentive Strategies to Modify Access, Purchasing and Consumption of Healthy and Unhealthy Foods and Beverages: A Systematic Review. Preventing Chronic Disease. 2017;14(1):E107. doi: 10.5888/pcd14.170213
16. **Trude ACB**, Anderson Steeves E, Shipley C, Surkan PJ, Sato P, Estep T, Clanton S, Lachenmayr L, Gittelsohn J. A Youth-Leader Program in Baltimore City Recreation Centers: Lessons Learned and Applications. Health Promotion Practice. 2017; 19(1):75-85. doi:10.1177/1524839917728048.
17. Gittelsohn J, **Trude ACB**, Poirier L, Ross A, Ruggiero C, Schwendler T, Anderson Steeves E. The Impact of a Multi-Level Multi-Component Childhood Obesity Prevention Intervention on Healthy Food Availability, Sales, and Purchasing in a Low-Income Urban Area. Int. J. Environ. Res. Public Health. 2017, 14(11), 1371

18. Garcia MT, Sato PM, **Trude ACB**, Eckmann T, Anderson Steeves ET, Hurley KM, Bógus CM, Gittelsohn J. Factors associated with home meal preparation habit among low-income African-American adults living in food deserts. Ecology of Food and Nutrition. 2018; 57(1):13-31. doi: 10.1080/03670244.2017.1406853.
19. Henry J, **Trude ACB**, Surkan P, Anderson Steeves E, Hopkins L, Gittelsohn J. Psychosocial Determinants of Food Acquisition and Preparation in Low-Income, Urban, African American Households. Health Education and Behavior. 2018 (online). doi.org/10.1177/1090198118760686
20. Loh H, Schwendler T, **Trude ACB**, Anderson Steeves E, Cheskin L, Lange S, Gittelsohn J. Implementation of social media strategies within a multi-level childhood obesity prevention intervention: Process Evaluation Results. Inquiry. 2018; 55(4): 004695801877918. doi: 10.1177/0046958018779189
21. **Trude ACB**, Kharmats AY, Jones-Smith J, Gittelsohn J. Exposure to a Multi-Level Childhood Obesity Prevention Trial: Patterns, Determinants, and Consequences. Trials. 2018; 19(1):287. doi:10.1186/s13063-018-2663-y
22. Ruggiero C, Poirier L, **Trude A**, Yang T, Schwendler T, Gunen B, Loh H, Perepezko K, Nam C, Sato P, Gittelsohn J. Implementation of B'More Healthy Communities for Kids: A Multi-Level, Multi-Component Obesity Prevention Trial. Health Education Research, cyy031, [doi.org/10.1093/her/cyy031](https://doi.org/10.1093/her/cyy031)
23. **Trude ACB**, Surkan PJ, Anderson Steeves E, Pollack Porter K, Gittelsohn J. The Impact of a Multilevel Childhood Obesity Prevention Intervention on Healthful Food Acquisition, Preparation, and Fruit and Vegetable Consumption on African American Adult Caregivers. Public Health Nutrition. (In press)

#### ***Under Review***

1. **Trude A**, Surkan PJ, Cheskin LJ, Gittelsohn J. A multilevel multicomponent childhood obesity prevention program improves healthier food purchasing and reduces sweet snacks consumption among low-income African American youth. Nutrition Journal. ID: NUTJ-D-18-00016.R1 (Under review)
2. Gittelsohn J, **Trude A**, Franco M, Miranda JJ. Culturally Targeted Obesity Interventions. The Lancet Diabetes & Endocrinology (Under review)
3. Anderson Steeves E, **Trude A**, Shipley C, Mejia Ruiz MJ, Jones-Smith J, Pollack K, Cheskin L, Hurley K, Hopkins L, Gittelsohn, J. Perceptions and Impact of a Youth-led Childhood Obesity Prevention Intervention among Youth-leaders. Journal of Hunger and Environmental Nutrition. ID: WHEN-2018-0053 (Under review)

4. Schmall, A, **Trude, A**, Shipley, C, Anderson Steeves, E, Nie, J, Gittelsohn, J. Process Evaluation and Lessons Learned on Program Sustainability from a Youth-Mentor Led Childhood Obesity Prevention Intervention. 2017 Health Promotion Practice (Under review)
5. Liu Y, **Trude ACB**, Ma Y, Ding N, Wensel CR, Brooke RN, Poirier L, Gittelsohn J, Wen D. Taking a Big Picture on Reducing Obesity: 'Diseases of Affluence' Paradigm May be Reversed by the Post-Materialistic Orientation Value Shift. BMJ Open. ID: 2017-020691 (Under review)
6. Chen E, **Trude A**, Shipley C, Gittelsohn J. Nutrition label reading is not associated with overall healthy food purchasing among low-income African American adults. Journal of Nutrition Education and Behavior ID: JNEB-D-17-00594 (Under review)
7. Schmall A, **Trude ACB**, Rajagopalan K, Hurley KM, Poirier LK, Gittelsohn J. Presence of salad bars in Baltimore City school cafeterias is associated with lower body mass index-for-age z-score among youth 10-14 years old. Public Health Nutrition. ID: PHN-SC-2017-1455 (Under review)
8. Setiono F, Jock B, Wensel C, **Trude A**, Poirier L, Pardilla M, Gittelsohn J. Associations between Food Consumption Patterns and Chronic Diseases and Self-Reported Morbidities in Six Native American Communities. Current Developments in Nutrition. ID: CDN-D-18-00071 (Under review)
9. Loh, IH, **Trude A**, Setiono F, Redmond L, Jock B, Gittelsohn J. Dietary Intake of Midwest and Southwest Native American Adults. Current Developments in Nutrition. ID: CDN-D-18-00093 (Under review).

#### Abstracts Published in Congress Annals

1. **Trude A**, Surkan PJ, Pollack Porter K, Cheskin LJ, Anderson Steeves E, Gittelsohn J. Child Obesity Prevention Trial Exposure Correlates with Greater Fruit Intake in Youth's Caregivers. Poster presentation at: The Obesity Society Annual Meeting at ObesityWeek<sup>SM</sup> 2018; Nov. 11-15, 2018; Nashville, TN.
2. **Trude A**, Surkan PJ, Ruggiero C, Anderson Steeves E, Gittelsohn J. The Impact of a Multilevel Obesity Prevention Program on Fruit and Vegetable Purchasing and Consumption among African American Adults. Poster Presentation at: American Society for Nutrition Annual Meeting, 2018; Boston, MA.
3. **Trude A**. Impact evaluation of a multilevel multicomponent childhood obesity prevention on diet and food-related behaviors among low-income African American children. Invited oral presentation at: International Society for

Behavioral Nutrition and Physical Activity (ISBNPA), 2018; Hong Kong.

4. **Trude A**, Surkan PJ, Ruggiero C, Loh IH, Gunen B, Poirier LK, Wensel C, Gittelsohn J. A Childhood Obesity Prevention Trial Reduces Sweets Intake Among African American Adolescents. Poster presentation at: The Obesity Society Annual Meeting at ObesityWeek<sup>SM</sup> 2017; Oct. 30 - Nov. 2, 2017; Washington, DC. [www.obesityweek.com](http://www.obesityweek.com).
5. **Trude A**, Anderson Steeves E, Lachenmayr L, Shipley C, Sato P, Gittelsohn J. Impact of a Multi-Level Multi-Component Food Environment/Behavioral Intervention on Youth Leaders. In: Experimental Biology, 2017, Chicago (Oral Presentation)
6. Schmall A, **Trude A**, Gittelsohn J. Process Evaluation of a Youth-Mentor Led: A Childhood Obesity Prevention Intervention at Urban Recreation Centers. In: Experimental Biology, 2017, Chicago, USA
7. Gittelsohn J, **Trude A**. Do pricing interventions work? Systematic review of the effectiveness of pricing incentives and disincentive strategies on purchasing and consumption of food and beverages. In: Healthy Eating Research, 2017, Saint Paul, Minnesota (Oral Presentation)
8. **Trude A**, Jones-Smith J, Chen E, Eckmann T, Gittelsohn J. Exposure to a Multi-level Childhood Obesity Prevention Trial: Patterns, Determinants, and Consequences. In: The Obesity Society, 2016, New Orleans, LA, USA.
9. **Trude A**, Anderson Steeves E, Shipley C, Mejia Ruiz MJ, Sato P, Lachenmayr L, Gittelsohn J. Sustaining the youth-leader program in Baltimore City recreation centers: formative research findings. In: Experimental Biology, 2016, San Diego (Oral Presentation)
10. **Trude A**, Anderson Steeves E, Talegawkar SA, Gittelsohn J. Household and Individual-level Determinants of Fruit and Vegetable Intake among Low-Income Urban African American Adolescents. In: The Obesity Society, 2015, Los Angeles, CA, USA.
11. **Trude ACB**, Kharmats A, Vedovato GM, Gittelsohn J, Oliveira MA, Martins PA. Mixed Land Use is Associated with Increased Walking for Leisure of Women Living in an Urban Area of Brazil. In: Obesity Week, Obesity Society, 2014, Boston.
12. **Trude ACB**, Vedovato GM, Kharmats A, Santana ANB, Gittelsohn J, Martins PA. Neighborhood Walkability is Associated with Increased Physical Activity of Women Living in an Urban Area of Brazil. In: Experimental Biology, 2014, San Diego (Oral presentation).

13. **Trude, ACB;** Mui, Y.; Gittelsohn J.; Martins PA. Factors Associated with Physical Inactivity among Women in Santos, Brazil. In: Experimental Biology, 2013, Boston.
14. **Trude ACB,** Santana AB, Vedovato GM, Oliveira MA; Martins PA. Factors Associated with Walking Behavior among Women from Urban Area in Santos/SP – Brazil. In: XVI Congreso de la Sociedad Latinoamericana de Nutrición (SLAN), 2012, Cuba.
15. **Trude ACB,** Santana AB, Vedovato GM, Oliveira MA, Martins PA. Factors associated with the use of a bicycle among Women from an Urban Area in Santos/SP. In: X Congresso Brasileiro de Saúde Coletiva, 2012, Porto Alegre
16. **Trude ACB,** Crenn E, Oliveira MA, Martins PA. Leisure-Time Physical Activity and the Use of a Bicycle among Women from an Urban Area in Santos/SP – Brazil. In: World Nutrition, 2012, Rio de Janeiro.
17. **Trude ACB,** Volpe CB, Ide JH, Crenn E, Scagliuse FB, Martins PA. Physical Activity of Mothers and Children from Santos, SP, Brazil. In: II World Congress of Public Health Nutrition and I Latin American Conference of Community Nutrition, 2010, Porto - Portugal. Anal of II World Congress of Public Health Nutrition, 2010. p. 255-255.

## **LANGUAGE AND COMPUTER SKILLS**

Portuguese: Native

English: Fluent

Spanish: Advanced

Statistical analysis: Stata, SPSS, Epi Info, MLWin

MS Office

NDSR software

ArcGIS

ATLAS.ti