2022

Examining the intention-behavior gap: The impact of the food environment on the eating behaviors of low-income African American women

Karen Glownia

Examining the Intention-Behavior Gap: The Impact of the Food Environment on the Eating Behaviors of Low-Income African American Women

by

Karen Glownia

Thesis

Submitted to the Department of Psychology

Eastern Michigan University

in partial fulfillment of the requirements for degree of

MASTER OF SCIENCE

in

Clinical Psychology

Thesis Committee:

Heather Janisse, Ph.D., Chair

Karen Saules, Ph.D.

Stephen Jefferson, Ph.D.

June 17, 2022

Ypsilanti, Michigan

Abstract

The current study investigated environmental barriers to the intention-behavior gap. The food environment was examined as a moderator between motivation for healthy living and actual eating behavior. A sample of 55 low-income African American women ($M_{\text{age}} = 30.25$, SD = 7.46) completed self-report motivation and eating behavior questionnaires. The food environment was measured by the number and proportion of healthy and unhealthy food retailers in one's neighborhood using ArcGIS mapping software. The results showed that greater motivation was associated with less unhealthy eating when there was relatively equal access to nearby unhealthy and healthy food retailers. When given both options, in the context of high motivation, individuals may be more likely to decline unhealthy foods consisting of high amounts of oils, fats, and sugars. A combination of motivational interventions and innovative food policy and urban planning initiatives may be needed to promote healthier communities.

Table of Contents

List of Tables

List of Figures

Introduction

Obesity affects nearly half of the United States adult population (42.4% as of 2018) and has increased by 12% over the last few decades (Hales et al., 2020). While this increase has extended across all racial/ethnic and income groups, large disparities in weight and health behavior exist (Hales et al., 2020). African American adults, for example, exhibit significantly higher rates of obesity (49.6%) than European American (42.2%), Asian American (17.4%), and Hispanic American adults (44.8%; Hales et al., 2020). Racial differences are further exacerbated by gender, with African American women having the highest obesity prevalence (56.9% as of 2014) in the United States (Hales et al., 2020; James et al., 2006). Moreover, the intersection of racial/ethnic minority group membership and low socioeconomic status has consistently been associated with greater body mass index (Hales et al., 2020; James et al., 2006).

This is a serious public health concern, given that overweight and obese adults face an increased risk for coronary heart disease, renal disease, type 2 diabetes, stroke, some cancers, and preventable premature death (Hales et al., 2020). Comorbid obesity also poses a risk in the context of other harmful ailments, such as COVID-19, in which impaired immune function and decreased lung capacity triple the rate of hospitalization (Alwarawrah et al., 2018; Simonnet et al., 2020). Moreover, the chronic nature of this condition produces significant medical costs that are estimated to be as high as $149.4 billion at the national level (Kim & Basu, 2016).

Among high-income countries, body mass index (BMI) can be the result of enhanced energy intake and a sedentary lifestyle, in which the number of calories consumed from foods and beverages is not sufficiently balanced with the number burned through activity (Chooi et al., 2019). As a result, excess energy is converted to triglyceride and stored in adipose tissues that expand in size, thereby increasing body fat (Chooi et al., 2019). Obesity, however, is a multifactorial disease, in which a myriad of behavioral, biochemical, and environmental factors influences the gene expression responsible for weight gain (Chooi et al., 2019). Family, twin, and adoption studies, for example, show moderate-to-high heritability for obesity (Ells et al., 2018). Emerging research suggests that such genetic predispositions are polygenic in nature and exacerbated by dietary patterns (Ells et al., 2018). In fact, Wang and colleagues (2018) found stronger associations between healthy diet and weight loss among individuals with a greater genetic predisposition for obesity. This suggests that improving diet quality may have a more favorable effect on weight management for those genetically predisposed to obesity (Wang et al., 2018). Accordingly, studies have shown that highly processed products such as sweets, sodas, and fried foods can magnify genetic associations with increased body mass index (BMI; Brunkwall et al., 2016; Qi et al., 2014).

There is also growing evidence emphasizing the human gut microbiota—a complex ecosystem residing in the gastrointestinal tract (GIT)—and its influence on weight-gain (Bliss & Whiteside, 2018). The gut-brain axis, for example, is a neurohumoral communication network that is imperative for maintaining metabolic homeostasis (Bliss & Whiteside, 2018). Communication within the brain-gut axis consists of hormonal, neural, and immunological signals that are relayed between the gastrointestinal tract and the regulatory appetite centers within the central nervous system (CNS; Buhmann et al., 2014). The hypothalamus integrates hormonal signals (i.e., leptin, ghrelin, glucagon, peptide YY, and insulin) that regulate satiety by transducing information regarding nutrient consumption and energy expenditure (Mansoor et al., 2021). Diet is imperative in defining and shaping the gut microbiota (Zhi et al., 2019). For example, in the context of obesity, westernized diets have been associated with an increased ratio of Firmicutes phylum to Bacteroidetes phylum bacteria, which can be reversed upon surgical and dietary intervention (Zhi et al., 2019). The gut microbiota serves a critical role in the breakdown of substances that cannot be otherwise decomposed by the stomach and intestines, allowing for more nutrient absorption (Zhi et al., 2019). Imbalances in the gut microbiota, often caused by high-fat diets, have been found to aggravate obesity through increased endotoxins, energy harvesting, short-chain fatty-acid (SCFA) signaling, and modulating inflammatory responses (Bliss & Whiteside, 2018).

Aside from genetics and the homeostatic system, numerous factors can influence eating behavior and subsequent weight gain. For example, stress, depression, and anxiety can create changes in appetite and food intake (Konttinen, 2020). There is also evidence that individuals with obesity have altered reward system circuitries that lead to, or exacerbate, weight gain by inducing hyperresponsivity to unhealthy food cues or inducing hyporesponsivity to rewards other than highly palatable foods (Blum et al., 2014; Meng et al., 2020; Upadhyay et al., 2017). This is evidenced by the lower availability of rewarding dopamine D2 receptors seen among individuals with obesity (Blum et al., 2014), as well as the heightened neural activity seen in the orbitofrontal cortex and nucleus accumbens in response to rewarding food cues (Morys et al., 2020). Accordingly, individuals who have obesity, or are prone to weight gain, show greater attentional biases toward food cues in the absence of hunger, as well as impaired inhibitory control in response to food cues (Meng et al., 2020; Upadhyay et al., 2017).

Current treatments for obesity largely consist of behavioral interventions, pharmacotherapy, and bariatric surgery (Mansoor et al., 2021). Other emerging treatments include fecal microbiota transplantation (FMT) as a means of normalizing the gut microbiota (Li et al., 2017). Importantly, lifestyle and behavioral interventions aimed at limiting calorie intake and increasing energy expenditure have limited effectiveness when administered in isolation, due to the complex hormonal, metabolic, and neurochemical factors that hinder weight loss and promote weight regain (Blüher, 2019). Nevertheless, addressing the obesity pandemic requires a multi-faceted approach of both medical and behavioral interventions (Blüher, 2019). Understanding the determinants of eating behavior are therefore critical for the development of obesity-related behavioral interventions.

Research on the determinants of eating behavior has primarily focused on individual-level factors, such as physiological/psychological states, taste preferences, nutrition knowledge, and motivation to eat healthfully (Leng et al., 2017; Marcone et al., 2020; McDermott et al., 2015; Munt et al., 2016). Accordingly, many obesity prevention and reduction efforts have utilized educational and motivational approaches to encourage the conscious adoption of healthier eating habits (Brug et al., 2005; Raynor & Champagne, 2016). Studies have shown that awareness of one's own unhealthy eating habits is associated with greater intention to make healthier dietary changes (Brug, 2008). Other studies propose that while some nutrition knowledge and motivation is a prerequisite for health behavior change, it is insufficient for meaningful long-lasting change (Brug, 2008). For instance, weight loss from diet-based interventions is often followed by progressive weight regain, as a result of induced compensatory regulatory responses (e.g., hormonal, metabolic, and cognitive/attentional changes) following calorie deprivation (Greenway, 2015; Hwalla & Jaafar, 2021; Werthmann et al., 2016). Such barriers to intervention effectiveness can preclude individuals from adopting long-standing healthy eating behaviors, even in the context of ample awareness and motivation.

This phenomenon of being unable to translate intention into action is referred to as the "intention-behavior gap" (Faries, 2016). It is particularly applicable to engrained health-related behaviors, in which there is a strong tendency for well-intentioned individuals to fall back on old habits (Allan & Campbell, 2008). However, little is known about the contextual variables that moderate this relation, particularly in the context of eating behavior. Thus, the objective of the current study was to examine the food environment as a moderator between motivation for healthy living and actual eating behavior. The purpose of this objective was to shed light on the concurrent influence of individual- and environmental-level factors on the eating behaviors of low-income African American women, as to identify risk factors that impede the effectiveness of motivation-based, behavioral interventions for obesity.

Eating Behaviors in the United States

The *2015-2020 Dietary Guidelines for Americans (DGA)* advise individuals to develop healthy eating patterns by regulating their calorie intake; eating a variety of fruits and vegetables; consuming whole grains and only fat-free or low-fat dairy; eating a variety of proteins; and limiting their intake of sodium, saturated fats, trans fats, refined grains, added sugars, and alcohol (U.S. Department of Health and Human Services and the U.S. Department of Agriculture, 2015). Per the report, total calorie counts should provide a range of vitamins and minerals and reflect the needs specific to one's age, sex, height, weight, and level of physical activity (U.S. Department of Health and Human Services and the U.S. Department of Agriculture, 2015). Healthy adult women (ages 19-50), for example, have estimated calorie needs of 1,600 to 2,400 calories/day (U.S. Department of Health and Human Services and the U.S. Department of Agriculture, 2015).

Nationwide survey data suggest that fewer than 1 in 10 Americans adhere to these recommendations (Kimmons et al., 2009)—with most overeating high-fat foods and neglecting nutrient-dense foods (Berrigan et al., 2003). When these unhealthy eating patterns occur concurrently, individuals can become both overweight and nutrient deficient (Tanumihardjo et al., 2007). While nutritional deficiencies are seen in both average- and over-weight populations, they are more common among those who are overweight or obese (Damms-Machado et al., 2012). Most often, patients with obesity show mineral deficiencies in magnesium, selenium, iron deficiency, chromium, and zinc, which can result from diets lacking dark green and leafy vegetables, fresh fruits, fortified dairy products, egg yolks, and whole grains (Kaidar-Person et al., 2008). Most foods available in the United States are not in nutrient-dense forms (U.S. Department of Health and Human Services & U.S. Department of Agriculture, 2015).

Disparities in Eating Behavior

As with the prevalence of obesity, there are disparities in eating behaviors across income and racial/ethnic groups. For example, cost constraints can result in diets that favor high fat/carbohydrate foods, such as highly processed snacks and sweets (Hall, 2018; Harrison & Taren, 2018). Mathematical diet modeling studies have simulated the impact of food budget reductions on eating behavior (Darmon & Drewnowski, 2015). Budget reductions resulted in energy-dense and low-nutrient food choices, with most participants decreasing their fruit, vegetable, meat, and fish intake and increasing their refined cereal, sweets, and added fat intake (Darmon & Drewnowski, 2008; Darmon & Drewnowski, 2015). Lower cost diets also reflected lower nutrient densities in vitamin C and β-carotene (Darmon & Drewnowski, 2008). Another study found that transforming a standard food diet (based on the US Department of Agriculture's Thrifty Food Plan) into a healthier alternative required a 17-19% greater food budget (Jetter & Cassady, 2006).

For this reason, there are nutrition assistance programs (e.g., Supplemental Nutrition Assistance Program [SNAP]) implemented at the federal and state level to minimize the effects of financial burden on eating behavior (Nguyen et al., 2015). Eligibility is typically contingent on having a gross income below 130% of the federal poverty level for households that do not include a person with a disability or age 60 and above (Wheaton & Tran, 2018). In 2015, SNAP assisted approximately 45.8 million people per month—more than one in eight Americans (Wheaton & Tran, 2018). Moreover, SNAP lifted approximately 10.3 million people out of poverty status in 2012 and decreased food insecurity among families by a third after six months of benefits (Carlson et al., 2016). To estimate the antipoverty effects of SNAP, the Census Bureau determined if a household's total resources were greater than or equal to their poverty level, using the Supplemental Poverty Measure (Wheaton & Tran, 2018). If a household's resources were above the SPM poverty level with SNAP benefits, but otherwise below the poverty level, the household was removed from poverty status by SNAP (Wheaton & Tran, 2018). SNAP benefits can only be redeemed at SNAP-authorized retailers, and thus, their geographic availability should be measured. Studies have found that higher-income, SNAP-ineligible households live in different retail food environments than SNAP households (Gorski Findling et al., 2018). In fact, grocery/other stores make up only 22% of SNAP-authorized retailers in the U.S., while convenience stores make up 45% (Gorski Findling et al., 2018).

Although food assistance programs may have lowered finance-driven food insecurity, significant disparities in overweight/obese status persist among racial/ethnic groups. For example, SNAP efforts have lowered BMI scores across their participant sample—but to a lesser degree among Black and Hispanic individuals than White individuals (Nguyen et al., 2015). This suggests that there are other prominent factors contributing to unhealthy eating patterns and weight gain. For example, cultural factors may contribute to differences in eating behaviors across racial/ethnic groups. Culture informs a community's values, norms, and practices and provides rules that govern behavior and are transmitted from one generation to another (Orji &

Mandryk, 2014). Specific foods, flavor preferences, and food preparation practices can hold connotative meanings that relate to family traditions, group identity or solidarity, and curative purposes (Airhihenbuwa et al., 1996; Liburd, 2003). Eating is also an important element of social gatherings, in which it can be considered impolite to refuse offered food and expected to provide generous amounts of food (Orji & Mandryk, 2014). Across qualitative studies, African American women have reported a highly ritualized nature to eating and food selection, referring to it as a "collective, communal event" (Liburd, 2003). Participants have also reported having eating patterns that are highly responsive and adaptive to what is available in the immediate environment (Airhihenbuwa et al., 1996; Liburd, 2003). Accordingly, many studies have investigated the role of macro-level factors, such as the food environment, on eating behavior.

Eating Behaviors Within Food Environments

Many authors have attributed complex changes in the food environment, and their subsequent impact on eating behavior, to the rise of obesity (Hall, 2018). Many studies have found unhealthy food outlets to be more abundant than healthy food outlets across neighborhoods, and their density and proximity to participant homes to be predictive of food choices (Gorski-Findling et al., 2019; Raskind et al., 2020). When conducting a study in Atlanta, Georgia, Raskind and colleagues (2020) found that 53.8% of the women in their sample had convenience stores nearby, while only 12.1% had a supermarket within 1 mile of their home. On average, the women traveled 3.6 miles to reach their primary supermarket. However, pre-existing research has yielded mixed results on the quality of residential food environments and their effects on health-related behavior (Odoms-Young et al., 2016).

Healthy Food Retailers

Some research suggests that access to healthy food retailers is a protective factor for healthy eating (Kraft et al., 2020). For example, a large literature review found that greater supermarket and grocery store availability was associated with lower weight status among a sample of low-SES adults (Kraft et al., 2020). Likewise, Morland and colleagues (2006) found that living in a census tract containing at least one supermarket was associated with a 9% decreased likelihood of being overweight and a 24% decreased likelihood of being obese. Moreover, a study conducted in Detroit, Michigan found that women who primarily purchased food at supermarkets (which are known to have a larger variety of high-quality foods at lower costs; Zenk et al., 2009b) ate more fruits and vegetables than those who relied on smaller grocery stores (Zenk et al., 2009a). Another study found that adding one supermarket per census tract was associated with a 32% increase in fruit and vegetable consumption among African American residents (Morland et al., 2002).

Other studies have suggested little to no influence. For example, Liese and colleagues (2014) examined eight counties in South Carolina, finding that most of their participants (55%) did not have a supermarket in their census tract. Healthy food availability in their neighborhoods was rated as a 6.3 out of 12 (Liese et al., 2014). Supermarket availability, however, did not influence fruit and vegetable intake in their sample. Using a path analysis, supermarket availability, in addition to perceptions of availability and access, explained minimal variation (3%) in fruit and vegetable intake (Liese et al., 2014). Importantly, the characteristics of this sample were distinct from the current study; with middle-class, middle-aged (average age 57), majority White (67%) participants who owned vehicles (94%). There is evidence to suggest that low-income populations are more responsive to food price changes and benefit more from having healthy options in their school food environment (Mackenbach et al., 2018).

According to Black and Macinko (2008), lower-income neighborhoods have fewer supermarkets per person and require longer travel times to reach the nearest food store. This lower availability and proximately to healthy food stores has been associated with worse health outcomes (Black & Macinko, 2008). For example, a study conducted in Los Angeles found that individuals who traveled farthest from their home to reach a grocery store were more likely to be obese (Inagami et al., 2006). Another study found that low-income pregnant women living over four miles from a supermarket were three times less likely to consume a healthy diet (Laraia et al., 2004). Likewise, low-income participants living over five miles away from their primary food store consumed less fruit than those living within one mile (Rose & Richards, 2004). Some studies have suggested otherwise, finding that although store distance and store prices were independently related to obesity, only price remained significant when both variables were included in analyses (Ghosh-Dastidar, 2014). Importantly, the only distinguishing factor between low-price and high-price store shoppers in this study was car access, with car ownership being associated with farther travel and lower-priced food shopping (Ghosh-Dastidar, 2014). On average, obese participants lived 3.5 miles away from a major shopping store, while non-obese participants lived 3.0 miles away (Ghosh-Dastidar, 2014). Approximately half of the low-income, predominately African American sample had access to a car (Ghosh-Dastidar, 2014).

Lastly, not all studies have found grocery stores to be protective against weight gain. Gorski and colleagues (2018), for example, found that overweight/obesity rates were higher with greater access to “combination grocery/other stores” for children enrolled in SNAP (Gorski Findling et al., 2018). However, this study did not distinguish between healthy and unhealthy food retailers, as their definition of combination grocery/other stores included convenience shops (e.g., independent drug stores, dollar stores; Gorski Findling et al., 2018).

Unhealthy Food Retailers

The modern food environment, often labeled “obesogenic,” can provide an abundance of easily accessible, energy-rich foods and drinks in large portion sizes (Larsen et al., 2017). While “obesogenic” environments do not directly cause obesity, they can provide conditions that encourage weight gain (Parise, 2020). For example, neighborhoods with fewer economic resources tend to have higher densities of convenience stores and fast-food restaurants, which have been associated with increased BMI (Briggs et al., 2019; Parise, 2020; Richardson et al., 2015). Multiple studies have found convenience store availability to be associated with overweight/obesity status among children and adults, even after controlling for individual-level covariates (Morland et al., 2006; Xin et al., 2021). Similarly, fast-food availability has been associated with greater unhealthy food consumption among African American adults (Wong et al., 2018). Studies looking at specific fast-food retailers (e.g., McDonalds and Burger King) have also found significant correlations with obesity at the state-level (Maddock, 2004). Others have found significant associations between the food environment and weight only for full-service restaurants (Li et al., 2015).

Proximity to unhealthy food retailers also plays a role. For example, Elbel and colleagues (2021) found that children (K-12) who lived farther than 0.025 miles (about 1/2 of a city block) from the nearest fast-food restaurant had a lower likelihood of being overweight/obese. Similar results were found for corner stores and small stores (< 2k sq. ft.), in which greater street network distances were related to better weight outcomes (Elbel et al., 2021). However, the food environment had no impact beyond this walkable distance. Other food retailers, such as restaurants and supermarkets, did not influence weight outcomes either (Elbel et al., 2021). These findings may be related to the characteristics of the children and adolescents in the sample, whose decisions were likely influenced by parental rules regarding neighborhood exploration, travel mode limitations, and greater vulnerabilities to tempting food cues.

Some authors posit that the abundance of unhealthy food retailers, in areas known as "food swamps," is even more impactful on eating behavior and obesity than the absence of healthy food retailers, in areas known as "food deserts" (Cooksey-Stowers et al., 2017; Zhen, 2021). For example, even after controlling for "food desert" effects, "food swamps" were found to be positively associated with adult obesity rates (Cooksey-Stowers et al., 2017). This effect was stronger in counties with greater income inequality and less transportation—in fact, there were no food swamp or food desert effects in counties with above average driving or public transportation use (Cooksey-Stowers et al., 2017). This suggests that individuals who do not have access to a personal vehicle or public transportation—and are thereby limited to walkable and bikeable distances—are more vulnerable to the negative effects of living in a food swamp (Cooksey-Stowers et al., 2017). Importantly, this study did not include convenience stores and gas stations, which are prevalent food retailers across urban areas. Briggs and colleagues (2019), on the other hand, examined multiple food retailers, finding that obesity was most strongly associated with high convenience store density and low full-service restaurant density at the county-level. Grocery store density was not related to adverse health behaviors, obesity, or cardiovascular health outcomes—which may have been a result of the wide variety of foods available at these establishments (Briggs et al., 2019). Other studies have found mixed results or null relationships between characteristics of the food environment and health outcomes (Fryar et al., 2016; Jeffery et al., 2006).

Large chain stores, which typically provide lower food prices than small stores, are less frequently available in lower-income urban areas (Chung & Myers Jr, 1999; Evans et al., 2015). When lower food prices are available, they are more likely to reflect worse food quality (Block & Kouba, 2006). As a result, many individuals travel outside of their neighborhood to shop for food (Dubowitz et al., 2015). For example, a study conducted in Pittsburgh found that only one neighborhood food retailer sold fresh produce (Dubowitz et al., 2015), prompting nearly all their participants to do major food shopping outside of their neighborhoods. Although the closest full-service retailer was on average 2.6 km from their homes, participants traveled approximately 6 km for food shopping. Most participants traveled by car and completed the roundtrip within 2 hours. Longer trips were associated with less frequent food shopping (about 2-4 times per month) and higher BMI (Dubowitz et al., 2015).

It is especially important to study the effects of urban food environments on eating behavior. The Detroit metropolitan area, for example, had the highest prevalence of food insecurity in the state (21%) in 2016 (Feeding America, 2018). The city's boundaries also hold spatially distinct neighborhoods that are differentiated by race and socioeconomic status (Schulz et al., 2002). Lower-income neighborhoods with large minority populations, in particular, have greater exposure to fast-food restaurants and fewer healthy food retailers (Kwate, 2008; Kwate et al., 2009). Researchers have theorized that recent trends deterring unhealthy eating in the larger population may be causing fast food corporations to increase their marketing to minority and low-income communities, as has been done for cigarette and alcohol advertising (Harris et al., 2019; Ohri-Vachaspati et al., 2015).

Mechanisms Relating Food Environments to Eating Behaviors

It is widely theorized that geographic food availability contributes to weight-related health disparities (Schulz et al., 2002). By living farther away from affordable and nutritious food retailers, families may spend more time and money to live a healthy lifestyle. When this increased cost and effort is not feasible day to day, families may settle on quick, low-cost, and low-nutrient food options in their neighborhoods (Neckerman et al., 2009). For example, a qualitative research study found that convenience was frequently reported as a determinant of food choice in their sample of African American women (Antin & Hunt, 2012). The most convenient food options were characterized as serving unhealthy foods (e.g., fast food restaurants; Antin & Hunt, 2012). It is likely that convenience trumps healthy foods choices when individuals are met with strict time and money constraints, or lack transportation means. Alternatively, it is possible that an abundance of nearby healthy food retailers inspires individuals to try healthier options.

Other research initiatives have focused on automatic cognitive processes that relate food environments to eating behavior—namely, food cues and stimulus control (Larsen et al., 2017). For example, food choices are shaped by associative learning mechanisms (e.g., classical and operant conditioning), in which food items that are high in fat, sugar, and salt offer intrinsic rewards and, in turn, shape food preferences and food-related motivation (Larsen et al., 2017; Watson et al., 2017). This results in automatic biases that draw individuals to unhealthy foods upon seeing a cue (e.g., seeing a fast-food retailer across the street; Larsen et al., 2017). Such biases can trigger engrained habits that make it harder to adhere to strict dietary goals (Gardner, 2013), even when there is a strong desire to change one's behavior.

Food cues can also induce overeating by intensifying the salience of food rewards, regardless of whether it occurs during a period of hunger (Ziauddeen et al., 2015). Such cues and their associated eating behaviors are mediated by the activation of brain reward circuitry (Figlewicz, 2016). Mesocorticolimbic and hypothalamic circuitry interact to produce motivation and reward for eating, in which internal metabolic cues are processed within the medial hypothalamus and later integrated into reward circuitries through the lateral hypothalamic area (Leigh & Morris, 2016). The mesolimbic reward pathway—consisting of the ventral tegmental area and nucleus accumbens in the ventral striatum—drives food-seeking behavior in response to energy deficits or in the presence of highly palatable foods (Leigh & Morris, 2016). When food cues are instilled with incentive salience through these circuitries, they become attractive to the observer and capable of eliciting cravings (Morales & Berridge, 2020). In fact, cue-triggered incentive salience can generate behavioral urges to seek and consume the associated food rewards regardless of the observer's active awareness (Morales & Berridge, 2020). This type of hedonic eating behavior is driven by pleasure, rather than metabolic need, and is particularly common among obesogenic environments (Liegh & Morris, 2016). Research also indicates that when a person is overloaded with numerous options, cognitive processing is more likely to be automatic, impulsive, and influenced by superficial characteristics (Ghosh-Dastidar et al., 2014)—suggesting that residents of urban environments, in which there is a plethora of fast-food options, may be particularly vulnerable to the effects of food cues.

Only several studies have examined the effects of the food environment, or the presentation of foods within one's environment, on participant eating behaviors through small-scale experiments (Raghoebar et al., 2019). Subtle changes in the spatial presentation of foods, for example, can influence food choice. One study found that food items placed in the middle of the vendor tray, opposed to the edge of the tray, were three times more likely to be chosen (Keller et al., 2015). Other studies have found that increasing the visibility of products increases their selection. For example, Kroese and colleagues (2015) found that placing foods next to the cash register doubled their sales. Likewise, increasing the proportion of healthy to unhealthy food options increased their odds of being chosen (Pechey & Marteau, 2018). Alternatively, it was found that increasing the distance to snacks by only a few feet decreased their intake (Maas et al., 2012). As is suggested by the research on automatic cognitive processes, food environments and their associated food cues were found to predict overconsumption through increased wanting and hunger (Joyner et al., 2017). However, scholars have found that the neighborhood food environment can predict snacking on top of direct food cue exposure, with there being a higher likelihood of high-energy snack intake in closer proximity to fast food restaurants and a higher likelihood of low-energy snacks in closer proximity to supermarkets (Elliston et al., 2017).

Importantly, individuals can differ in their responsiveness to food cues. Restrained eaters, for example, are more likely to attend to food cues than unrestrained eaters (Polivy & Herman, 2017). Thus, those attempting to limit their diets to healthier foods may be more susceptible to environmental food cues and, as a result, have a harder time resisting temptation upon seeing an attractive food retailer. While food cues can be altered within the home (e.g., hiding snacks in the top cabinet), food cues within one’s immediate built environment are more difficult to avoid. Accordingly, characteristics of the built food environment, in conjunction with food cue sensitivity, have been found to predict food consumption in children (Paquet et al., 2017).

Others have suggested that food consumption is guided by social norms that are physically embedded in food environments (Raghoebear et al., 2019). These social norms inform individuals of what is appropriate to eat outside of the home. Thus, it could be reasoned that neighborhoods who have readily available unhealthy foods convey social norms that favor unhealthy eating (Raghoebear et al., 2019).

The Intention-Behavior Gap

Theories of Intention and Behavior

Several theories on health behavior, such as the theory of reasoned action and planned behavior and Bandura's social cognitive theory, propose that intentions are precursors to behavior change (Black & Macinko, 2008; Miller et al., 2017; Park et al., 2014). The transtheoretical model (TTM) describes behavior change as one's progression through a series of stages: pre-contemplation (no intention to change behavior), contemplation (intention to change), preparation (readiness to change), action, and maintenance (Park et al., 2014; Prochaska & Velicer, 1997). A limitation of this model is its linear progression, despite the well-documented occurrence of relapsing into previous stages (van Leer et al., 2008). Likewise, the categorical nature of the stages downplays the potential for inter-stage membership (e.g., feeling self-efficacious about implementing lifestyle changes but largely unmotivated to do so).

Recent conceptualizations of behavior change have instead emphasized continuums of perceived importance and confidence (van Leer et al., 2008). Taken together, the perceived importance of change and confidence for change are believed to add up to an individual's total intent, or motivation, to act (van Leer et al., 2008). According to van Leer and colleagues (2008), individuals can belong to one of four categories: high importance/high confidence, high importance/low confidence, low importance/high confidence, or low importance/low confidence. Individuals who rate themselves high in importance and confidence are most likely to feel ready to change their behavior. Alternatively, those who report low importance and high confidence (e.g., "I could do it, if I put my mind to it") or high importance and low confidence (e.g., "I should change, but I am not sure I can") are less likely to feel prepared for behavioral change. Individuals who are low in both dimensions reflect the least readiness for behavior change (van Leer et al., 2008).

This conceptualization is based on the Readiness Ruler, a measure that helps individuals evaluate the importance of their desired changes and their confidence in making those changes (Moyers et al., 2009). The Readiness Ruler is a key component of motivational interviewing (MI)—an evidence-based treatment for facilitating behavior change through the enhancement of motivation and resolution of ambivalence (Azami et al., 2020; Mirkarimi et al., 2015). Research suggests that MI is an effective intervention for weight loss and eating behavior change among reproductive-aged women with overweight or obesity status (Azami et al., 2020; Mirkarimi et al., 2015). Moreover, several systematic reviews have demonstrated modest effectiveness for MI in health-related change (Armstrong et al., 2011; Barrett et al., 2018), with change talk—participants' statements about their desire for change and confidence in change—being a mechanism of behavior activation (Catley et al., 2021).

Incongruences Between Intention and Behavior

Holding a strong goal intention (e.g., wanting to eat more fruits and vegetables), however, does not guarantee goal achievement (e.g., altering one's diet to eat more fruits and vegetables; Gollwitzer & Sheeran, 2006). In fact, some people never adopt their desired lifestyle behaviors or fall back on old habits (Allan & Campbell, 2008). Between-group designs, for example, often mask individual variation that precludes many participants from benefiting from motivation-driven weight loss programs, as is suggested by the limited effectiveness of many MI interventions (Barrett et al., 2018). Even when weight and lifestyle improvements are seen postintervention, most people regain their lost weight within one year of the intervention (Sumithran, 2013). This frequent inability to translate goal intentions into actions is known as the "intention-behavior gap" (Faries, 2016). Meta-analyses suggest that intention predicts only 30-48% of the variation in health-related behavior (Faries, 2016; Rhodes & de Bruijn, 2013).

In the context of eating behavior, one study examined the intention-behavior gap among mothers of overweight children in England, finding incongruences between motivation for healthy eating and actual dietary intake (Park et al., 2014). Specifically, expressing an interest in eating more healthfully, after being notified of their child's overweight status, did not predict healthy eating behavior at follow-up (Park et al., 2014). While 72.1% of parents wanted to change their dietary intake, only 54.7% showed positive behavior changes (Park et al., 2014). However, a limitation of this study was that it did not assess the strength of intention, meaning that it was unclear how motivated these parents were to change their diets. The strength of intention is likely important to measure, with a meta-analysis finding that a substantial increase in intention is needed to produce a minor increase in the desired behavior (Sheeran & Webb, 2016).

Generalizability is another limitation of the pre-existing research on the intention-behavior gap, given that most participant samples have historical consisted of European and Canadian undergraduate students, university employees, and middle-class community dwellers. This lack of knowledge particularly extends to low-income minority groups who are most vulnerable for unhealthy eating behaviors and often face additional barriers in translating their intentions into behaviors. Thus, it is important to examine the intention-behavior gap among low-income African American women.

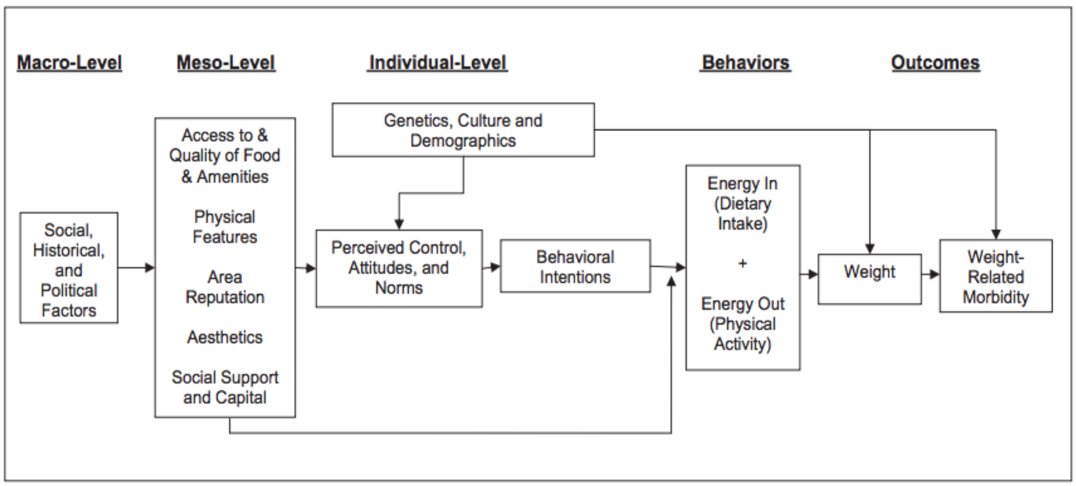
Moderators Between Intention and Behavior

Moderating factors of the intention and behavior discrepancy have been minimally studied. The majority of what has been studied, across a series of health-related behaviors, has focused on factors within the theory of planned behavior (e.g., attitude, subjective norms, perceived behavioral control; Ajzen, 1991; Armitage et al., 2001; Kothe et al., 2015; Rhodes & Dickau, 2012), anticipated affective reactions (Abraham & Sheeran, 2003; Conner et al., 2015; Sheeran & Abraham, 2003), personality (e.g., extraversion; MacCann et al., 2015; Monds et al., 2015; Rhodes & Dickau, 2012), participant demographics (e.g., age and income; Amireault et al., 2018), self-efficacy and action control (e.g., self-monitoring and effort; Rhodes & Dickau, 2012; Sniehotta et al., 2005), intention stability (Conner et al., 2015; Kothe et al., 2015; Rhodes & Dickau, 2012), planning or implantation intentions (Reuter et al., 2008; Rhodes & Dickau, 2012; Sniehotta et al., 2005; Wieber et al., 2015), and automatic cognitive processes (e.g., habit; Kothe et al., 2015; Larsen et al., 2017). A systematic review of lifestyle interventions for obesity has indicated that self-regulatory mediators—such as the lack of autonomous motivation, self-efficacy, and self-regulation skills—are most frequently studied and associated with relapses in weight gain (Teixeira et al., 2015).

Overall, pre-existing research has predominately examined internal factors as moderators of the intention-behavior gap, while largely neglecting the role of macro-level factors (e.g., the external environment). One study, however, examined the moderating role of the environment as it pertains to physical activity, finding that the perception of closer access to exercise facilities was predictive of a more consistent intention-behavior association (Rhodes et al., 2006). It is likely that environmental characteristics similarly moderate the intention-behavior gap in the context of eating. For example, it is intuitive to assume that greater environmental barriers could impede one's ability to alter their behavior, despite having genuine intentions to change. Accordingly, Black and Macinko (2008) created a framework outlining the ways in which environmental characteristics could influence weight gain—specifically noting food accessibility as a potential moderator of behavioral intentions and dietary intake (see Figure 1).

Figure 1

Factors Contributing to Weight Gain and Weight-Related Morbidity



Note. From "Neighborhoods and Obesity," by J. L. Black and J. Macinko, 2008, *Nutrition Reviews, 66*(1), p. 12 (https://doi.org/10.1111/j.1753-4887.2007.00001.x). Copyright 2008 by Oxford University Press. Reprinted with permission.

However, this proposed framework currently lacks empirical support. Little is known about what environmental barriers impede healthy eating (e.g., an abundance of nearby fast-food retailers, or the lack of nearby supermarkets), and how much motivation is needed to justify the extra effort imposed by a barrier. As mentioned, pre-existing research on the food environment and eating behavior has yielded mixed findings. It could be that eating behavior is shaped by an interaction of internal and external factors (e.g., the food environment may only facilitate healthy eating in the presence of adequate motivation to eat healthfully). Thus, the primary objective of this study was to examine how characteristics of the food environment moderate the relation between intention to eat healthfully and actual eating behavior.

Methodological Considerations for Food Environment Research

While it may seem intuitive that low-resource communities affect their residents' health, drawing the line between environments that are classified as promoting or discouraging good-health behaviors is less clear. This gap in knowledge is, in part, due to the difficulty of measuring the food environment and, in turn, the thwarted ability to assign causal inference between environmental characteristics and human behavior.

Comparing Subjective and Objective Measures

Subjective and objective measures of similar environmental constructs can have independent associations with diet and weight-related outcomes (Saelens et al., 2018). Subjective measures (e.g., surveys, interview, food diaries) have been predominantly used for data collection on resource availability and accessibility in health psychology (Minaker et al., 2011). There are advantages to using subjective measures to study environmental characteristics, in that participants' personal assessments are more likely to represent their actual, lived experiences (Skinner et al., 2014). For example, perceptions of food access can guide where neighborhood residents shop, how often they shop, and what food items they buy. On the other hand, there is the potential for self-reporting bias, which may affect the accuracy of the neighborhood descriptions. In this sense, subjective measures may be limited in their large-scale utility, particularly for identifying areas in need of more food retailers or healthier food options.

In contrast, geographic information systems (GIS) provide objective assessments of the food environment using interactive spatial maps (Caspi et al., 2012). GIS is a "computer system capable of assembling, storing, manipulating, and displaying geographically referenced information" (Lo & Yeung, 2002, p. 2). Through this system, researchers can measure the food environment by plotting the number of food outlets within a given area. The GIS method allows for a quicker and more cost-effective way of identifying neighborhoods in need of intervention, and thus, has dominated public health research initiatives in recent decades. Moreover, GIS can minimize concerns over same-source bias if data are collected from several externally verifiable sources (Caspi et al., 2012). However, studies utilizing GIS methods have yield mixed results regarding the quality of residential food environments and their effects on health-related behavior, due to the numerous ways to conceptualize the food environment (Odoms-Young et al., 2016).

Establishing Neighborhood Boundaries

A main challenge of using GIS systems is being able to define and operationalize the boundaries of the neighborhood (Diez Roux, 2018). Most often, pre-established boundaries (e.g., census tracts, zip code zones, and counties) are used to examine food access (Chen, 2017). In a process known as the container method, points of interests (e.g., food stores) are aggregated onto a map layer with the administrative boundaries to create a total count per unit (Chen, 2017). The main limitation of using administrative units is that they can differ in size, and thus, create an illusion of more resources in areas with vaster boundaries. Moreover, families who live on the edge of a border can have access to very different resources (that are perhaps even outside of their administrative unit) than those located elsewhere in the unit. Therefore, the present study will use a circular buffer method—a method of calculating the number of resources around a specific focal point (e.g., participant's address; Chen, 2017). This method has been recommended by the environmental domain subgroup of the Accumulating Data to Optimally Predict Obesity Treatment (ADOPT) Core Measures Project (Saelens et al., 2018). When setting a buffer around a participant's address, the radius can be based on walkability indicators and preferences in length of travel (Chen, 2017). National estimates have shown, for instance, that American families travel approximately 5 to 20 minutes to reach grocery stores, with residents of lower-income areas spending the most time traveling to grocery stores (19.5 minutes, in comparison to the national average of 15 minutes; Brown & Borisova, 2017). For densely packed urban areas, in which residents are more likely to travel by foot, researchers may opt to use a walkable radius of 0.25-2 miles (Charreire et al., 2010; Chen, 2017). Some have defined low access as being more than 1 mile from a supermarket/grocery store in an urban area, or more than 10 miles in a rural area (Elbel et al., 2021). The 1-mile access measure, in particular, has been found significant for urban residents through a series of sensitivity analyses (Gorski-Findling et al., 2018).

Food Environment Conceptualization

Supermarkets are assumed to provide a large selection of healthy items—such as fresh produce, whole-grain bread, and low-fat milk—for more affordable prices than smaller food retailers (Neckerman et al., 2009). Thus, research on the food environment has predominately looked at supermarket accessibility, under the assumption that supermarkets are protective factors for healthy eating (Charreire et al., 2010; Kraft et al., 2020; Zhou et al., 2019). Other important food outlets, such as restaurants, have been largely understudied in comparison to supermarkets (Charreire et al., 2010). This is a significant gap in the literature, given the increasing frequency of Americans dining out—specifically, it is estimated that Americans consume 32% of their daily calories outside of their home (Guthrie et al., 2002; Story et al., 2008). While there is substantial variation among restaurants, it is generally assumed that dining out is associated with higher-calorie and lower-nutrition food intake than eating at home (Guthrie et al., 2002). Studies have even shown that some full-service restaurants are just as high or higher in fat, cholesterol, and sodium as fast-food restaurants (Blisard et al., 2006). It may also be that large portion sizes in restaurants incite overconsumption; for instance, it is common for restaurants to have food portions that are over twice as large as the standard serving size and contain half to one day's worth of recommended calories (1100-2350 calories; Guthrie et al., 2002). For these reasons, the current study will measure various types of food outlets, as to provide a more comprehensive understanding of the food environment.

The Present Study

The preliminary objectives of this study were to determine the proportion of low-income African American women at each stage of behavior change upon enrolling in a family-focused obesity intervention. To address the limitations of the TTM, behavior change was conceptualized using a readiness continuum (Miller & Rollnick, 2002; van Leer et al., 2008), in which participants were classified into one of four categories: low importance/low confidence, high importance/low confidence, low importance/high confidence, or high importance/high confidence.

Next, the primary objective of the study was to examine environmental moderators of the intention-behavior gap. Specifically, this project examined how motivation for healthy eating predicted actual eating behavior in the context of food retailer availability and deprivation (considering both healthy and unhealthy food retailers in one's environment). Given the complexity of conceptualizing the food environment and its influence on eating behavior, the food environment was measured in two ways to account for two different theoretical mechanisms of influence. Primary analyses addressed geographical availability by measuring the food environment as the number of healthy and unhealthy food retailers per neighborhood. Next, exploratory analyses measured geographical accessibility by calculating the proportion of healthy to unhealthy food retailers within one's neighborhood, as to address the theoretical impact of environmental food cues on eating behavior.

The purpose of this study was to provide valuable insight into why individuals may continue to engage in unhealthy eating behaviors despite having genuine intentions to change. Moreover, understanding the moderating role of the food environment could help identify communities that are most likely to benefit from weight-regulation interventions, focused specifically on altering eating behavior though educational and motivational strategies, by allowing researchers to identify locations that are conducive for initiating and sustaining positive behavior change. Importantly, this project focused on a sample of low-income African American women—a population particularly susceptible to unhealthy eating and neighborhood food scarcity.

Hypotheses

1) Motivation for healthy eating would be related to eating behavior.
   a) Motivation for healthy eating would be positively associated with healthy eating behavior and negatively associated with unhealthy eating behavior.
2) The food environment, measured by two distinct distances, would be related to eating behavior.
   a) Food environments with more healthy retailers would be positively associated with healthy eating behavior and negatively associated with unhealthy eating behaviors.
   b) Food environments with more unhealthy retailers would be negatively associated with healthy eating behavior and positively associated with unhealthy eating behaviors.

3) The relation between motivation for healthy eating and actual eating behavior, measured by intake of fruits, vegetables, fats, sweets, and sodas, would be moderated by characteristics of the food environment.
   a) (Primary) The relation between motivation and healthy eating (fruit & vegetable intake) would be facilitated by food environments with more healthy retailers and less unhealthy retailers at two distinct distances.
   b) (Primary) The relation between motivation and unhealthy eating (fat, oil, sweets, and sodas) would be thwarted by food environments with more healthy retailers and less unhealthy retailers at two distinct distances.
   c) (Exploratory) The relation between motivation and healthy eating (fruit & vegetable intake) would be thwarted by food environments with a greater proportion of unhealthy retailers than healthy retailers at two distinct distances.
   d) (Exploratory) The inverse relation between motivation and unhealthy eating (fat, oil, sweets, and sodas) would be mitigated by food environments with a greater proportion of unhealthy retailers than healthy retailers at two distinct distances.

Method

Participants

Participants were part of a larger study of child and family health in Detroit, Michigan. Eligibility for the larger study was contingent on having a preschool-aged child enrolled in Head Start. Families were oversampled for child BMI scores at or above the 85th percentile. Because the sample was recruited from Head Start in Detroit, participants had a low-income status and were primarily African American. Due to the larger study's use of at-home intervention and data collection methods, eligible participants were required to reside in homes that met adequate safety requirements: clear exits for research assistants, no presence of drugs/alcohol or intimidating family members, no pests or other hazards within the home, nearby street parking available (see Appendix A). No participants were omitted from the study at baseline due to unsafe homes.

A total of 55 families were found eligible, provided informed consent, and participated in the baseline data collection (see Appendix B for the consent form). The adult, primary caregiver was used as the participant in the current study. The average parent age was 30.25 years old (*SD* = 7.46). From this sample, 91% of the primary caregivers were mothers, who were either were single (70%), married (18%), or living with a partner (12%). Nearly all participants identified as African American (97%); 58% of the participants completed high school, while 42% completed college or higher; 33% were full-time employed, 36% were part-time employed, and 31% were unemployed at the time of data collection. The median annual household income was between $5,000 and $9,999. Most participants rated their current health as being either average (39%) or good (41%), while some rated their health as excellent (14%) or poor (6%).

Procedure

Recruitment

The current study utilized secondary data from a larger intervention study of child and family health. It utilized data from the baseline assessment before the randomization or intervention procedures began. Participants were recruited from two Head Start agencies who serve low-income, primarily African American families throughout Detroit, Michigan. A nutrition coordinator at each agency identified families who potentially met the child BMI eligibility criteria. Eligible families were then given recruitment flyers for the larger study by their child's classroom teacher (see Appendix C for the recruitment flyer), and later contacted by research assistants through telephone calls. Half of the families who were reached by phone agreed to a baseline home visit. Home visits were scheduled with interested families to complete the consent process and baseline data collection.

Data Collection Procedures

Data collection began in 2013 for the study's first time point. A two-person team of research assistants (graduate-level and undergraduate-level) visited each family's home for approximately 2-2.5 hours. The first part of the visit included the informed consent process, in which the research assistants orally explained the consent form and gave each participant the opportunity to ask questions. Primary caregivers provided written consent on behalf of themselves and their preschool-aged child.

During the baseline data collection, the primary caregivers were asked to complete a series of survey questionnaires. This investigation specifically utilized data concerning the caregivers' demographic characteristics, motivation for healthy eating, and dietary intake (see Appendix D, Appendix E, and Appendix F, respectively). Additional measures were collected for the larger study that were not utilized. Each family was compensated a total of $30 for their participation in the baseline home visit.

Research Assistant Training

The larger study's principal investigator trained graduate-level research assistants on the following study procedures: participant recruitment, consent collection, and assessment completion. Trainings were completed through group meetings, and all training procedures were collapsed into an operating manual for future reference. Graduate-level research assistants then trained undergraduate-level research assistants on general human subjects' procedures through the Collaborative Institutional Training Initiative "CITI program."

Measures

Demographic Information

A self-report survey was utilized to collect demographic information. Variables, including age, race/ethnicity, socioeconomic status, employment status, marital status, educational attainment, and food stamp participation were collected.

Motivation for Healthy Behavior

The terms motivation and intention are used interchangeably in the literature to characterize a general drive to change or act in a particular way (Faries, 2016). Participants' motivation to eat healthfully was measured using an adaptation of the *Readiness to Change Questionnaire* ("The Readiness Ruler;" see Appendix E; Rollnick et al., 1992). For this study, a composite variable was created using four items, assessing participants' perceived level of importance and confidence in eating more fruits and vegetables and living a healthier lifestyle. Responses were given on a 10-point scale (1 = *not at all important* to *10 = extremely important*). Psychometric findings suggested the measure had satisfactory reliability—demonstrating an internal consistency Cronbach's alpha coefficient of .80 and a test-retest correlation of .86 (Rollnick et al., 1992).

The Readiness Ruler is a tool used in motivational interviewing (MI), an evidence-based treatment designed to help individuals cultivate interest making meaningful life changes (e.g., relating to diet, exercise, physical and mental illness symptom management, and alcohol/tobacco/other drug reduction; Moyers et al., 2009). The measure helps individuals evaluate the importance of their desired personal changes and their confidence in making those changes (Moyers et al., 2009; Center for Evidence-Based Practices at Case Western Reserve University, 2010). These questions elicit reflection and talk among participants about their intention, commitment, readiness, and willingness to change, as well as the steps they are already taking towards behavior change (Moyers et al., 2009). These constructs, assessing importance and confidence in behavior activation, are regularly used as indicators of motivation within the MI theoretical framework (Moyers et al., 2009).

Eating Behaviors

The *Block Brief 2000 Food Frequency Questionnaire* (*Block Brief 2000 FFQ*; Block et al., 1990) was utilized to attain self-reported measures of eating behavior. The *Block Brief 2000 FFQ* is a 70-food item scale that takes approximately 15-20 minutes to complete. Participants were asked to recall their intake of each food type on a 9-point scale (1 = *never,* 2 = *a few times per year*, 3 = *once per month,* 4 = *2-3 times per month*, 5 = *once per week,* 6 = *twice per week*, 7 = *3-4 times per week,* 8 = *5-6 times per week*, 9 = *everyday).* Each food type was then assessed for serving size on a 4-point scale (1 = *¼ cup of food,* 2 = *½ cup of food,* 3 = *1 cup of food,* 4 = *2 cups of food*). Participants were given a handout with pictures of serving sizes to reference when completing this part of the survey (see Appendix F). Given the copyrighted nature of the questionnaire, these data were sent to NutritionQuest (www.nutritionquest.com) for processing. For this study, two composite variables were created to reflect healthy food intake (daily servings of vegetables and daily frequency of fruits and fruit juices) and unhealthy food intake (daily servings of fats, oils, sweets, and sodas).

The 70-food items in this measure were derived from the National Health and Nutrition Examination Survey (NHANES III) dietary recall data (Wakimoto & Block, 2001). Its validation was approximated by an earlier version of the Brief, which demonstrated relatively little loss in the use of a reduced version of the full-length Block FFQ (correlations of *r* between .6 to .8

among most nutrients; Block et al., 1990). Nutrient count comparisons derived from Block FFQ questionnaires and diet records showed correlations greater than .70 (Block et al., 1986).

Neighborhood Food Environment

Data Sources and Variable Conceptualization. For the primary analyses, food retailer availability was measured by the number of food retailers that were in each participant's residential neighborhood in 2014—the year of baseline data collection. For the exploratory analyses, these separate counts of healthy and unhealthy food retailers per neighborhood were converted into a proportion variable, representing the percentage of healthy options among all the food retailers within a given neighborhood. The total number of food options was analyzed as a covariate. The historical food retailer data were extracted from Data Axle Reference Solutions (previously called ReferenceUSA), a source of business and residential information for reference and research (Data Axel, 2021). These data were organized by Standard Industrial Classification (SIC) codes, assigned by U.S. government agencies to classify industry areas (SICCODE.com, 2020)). Unhealthy and healthy retailers were identified by their primary SIC codes (see Table 1 and 2).

For this study, unhealthy food retailers were defined as restaurants, carry-out food outlets, pizza parlors, doughnut shops, and convenience stores (see Table 1). Research has suggested that restaurants with full or limited services are associated with higher-calorie and lower-nutrition food intake (Guthrie et al., 2002). In fact, many full-service restaurants are just as high or higher in fat, cholesterol, and sodium as fast-food restaurants (Blisard et al., 2006; Guthrie et al., 2002). Pizza and doughnut shops are widely accepted as unhealthy food outlets. Likewise, convenience stores, such as those located at gas stations, "tend to carry mainly processed forms of food versus unprocessed staple forms" in their limited selections of prepared and ready-to-eat foods and fountain beverages (Stilley, 2012, p. 13). In fact, one study found that families spent 26% of their weekly convenience store spending on sugary beverages, suggesting that significant amounts of empty calories are derived from these limited store types (Gorski Findling et al., 2019).

Table 1

System Industry Classification (SIC) Code of Unhealthy Food Retailers in Detroit, MI

SIC Code	SIC Code Description
581206	Foods-Carryout
581208	Restaurants
581222	Pizza
546105	Doughnuts
541103	Convenience Stores

Table 2

System Industry Classification (SIC) Code of Healthy Food Retailers in Detroit, MI

SIC Code	SIC Code Description
541105	Grocers Retail
541101	Food Market
543102	Farm Market
543101	Fruit and Vegetable Produce Retail
542107	Meat Retail
581209	Delicatessens

Healthy food retailers, on the other hand, were defined as grocery stores, food markets, farm markets, delicatessens, and other retailers that specifically sell fruits, vegetables, and fresh meat products (see Table 2). According to Burns and Inglis (2007), supermarkets are “the most likely outlets to provide the range and price of food required for a nutritionally adequate and affordable diet” (p. 878). Likewise, smaller grocery stores and markets also provide access to fresh and healthy food choices, such as vegetables and fruits, meat and beans, breads and cereals, and dairy products (Almadan, 2015). Grocery stores with membership fees were excluded from analyses, given their potential to disadvantage low-income individuals (Almadan, 2015).

Data Manipulation. GIS tools were used to create interactive spatial maps of food retailer availability, as a means of measuring the neighborhood food environment. First, the obtained food retailer addresses, along with the participant home addresses, were converted into latitude and longitude coordinates. Next, a GIS software called ArcGIS Pro was used to geocode the food retailer and participant home coordinates from a tabular format into a geographic format, based on their geographic locations (see Figure 2 and 3). The food retailer data were broken down into different map layers, so that qualitative analyses could show the quantity and variation of food retailers in each given neighborhood. Next, the input points making up the Detroit food environment were linked to the map layer containing the participant home locations. Through the ArcGIS buffer analysis and spatial join tools, Euclidean buffer polygons were first placed around the participant home locations to a specified distance (see Figure 4), allowing us to obtain the number of food retailers within each designated space. Given that the study’s data points were concentrated in a relatively small area, Euclidean buffers, which measure distance in a two-dimensional plane, were chosen over Geodesic buffers, which account for the actual shape of the earth when calculating distances (Flater, 2011). For this study, the neighborhood food environment was defined by two distances—a 1/2-mile and 2-mile buffer around the participants' homes. These distances are frequently utilized in the GIS literature, and they account for the average travel estimates reported by residents of urban areas when shopping for food items (Gorski Findling et al., 2018). The use of two distances was intended to account for different modalities of travel, such as walking and driving.

Figure 2

ArcGIS Map of the Unhealthy Food Retailers Within the Detroit Metro Area

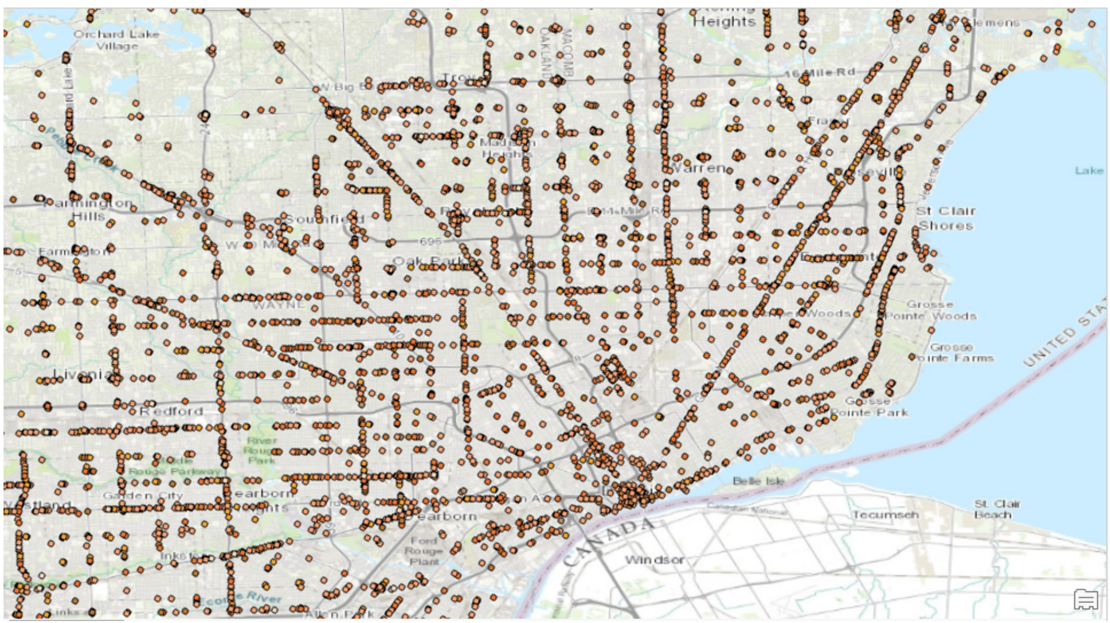


Figure 3

ArcGIS Map of the Healthy Food Retailers Within the Detroit Metro Area

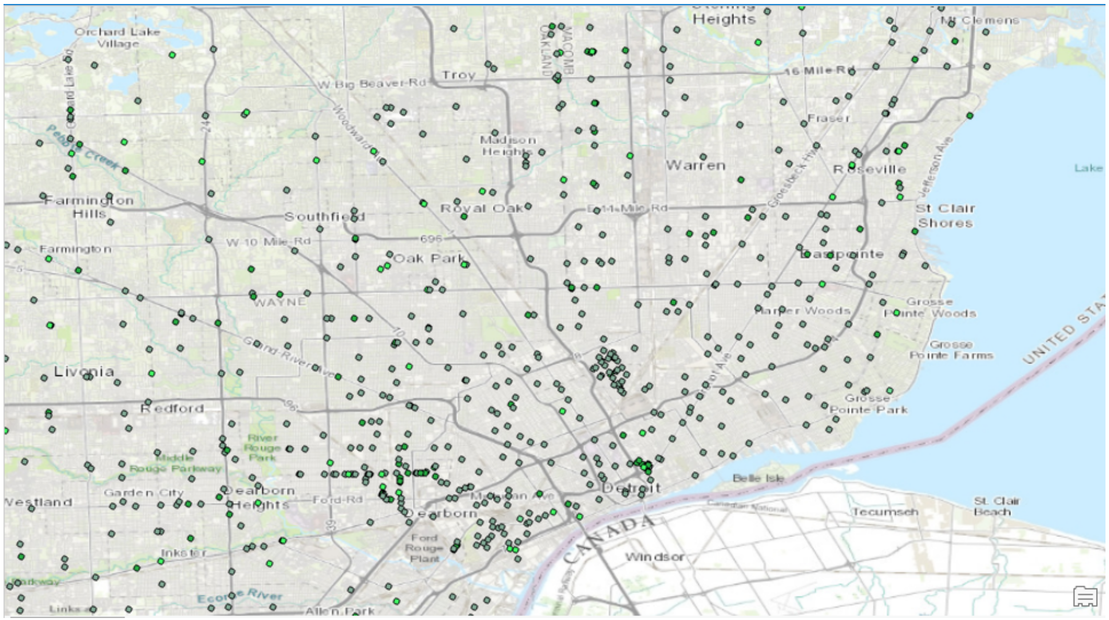
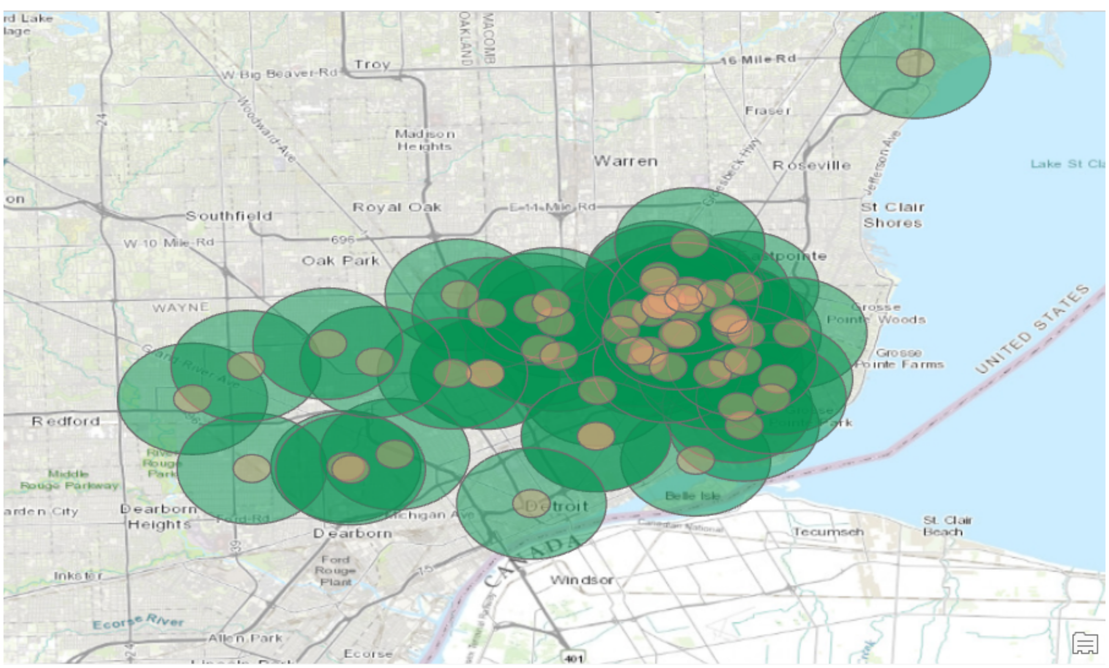


Figure 4

ArcGIS Map of Euclidean Buffer Polygons Around Participant Home Addresses



Note. Euclidean buffer polygons were set to a 1/2-mile and 2-mile radius around the participants' home addresses.

Data Analysis

Descriptive Statistics

ArcGIS Pro was used to examine characteristics of the food environment. As mentioned above, buffer analyses and spatial join analyses were conducted to obtain the number of healthy and unhealthy retailers in each participant's residential neighborhood across two distances (1/2-mile and 2-mile radius). The "summarize within" function on ArcGIS was used to obtain SIC-code-level descriptive information within the participant neighborhoods. Using the spatial analyst extension on ArcGIS, kernel density estimation analyses were conducted to qualitatively assess the distribution of healthy and unhealthy food retailers within the Detroit Metro Area. This analysis involved the creation of a magnitude-per-unit, curved surface map from food retailer address points. The surface value was highest at the food retailer's exact location and diminished in value over a 2-mile circular buffer (reaching zero at the edge of the radius). Higher kernel values represented more food retailer points in close proximity.

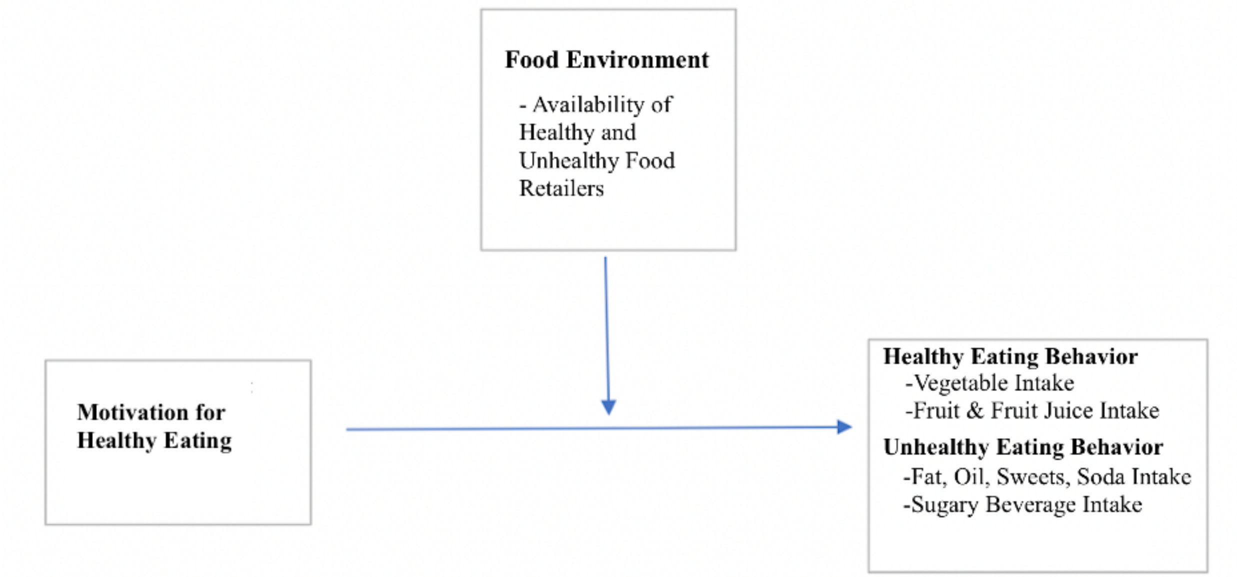
SPSS descriptive statistics were utilized to examine trends in eating behavior. When applicable, paired samples t-tests were used to assess for significant differences within variable composites. Average and range calculations also assessed the degree of motivation, as defined by importance and confidence, for healthy behavioral change reported among the at-risk sample of low-income African American women. Frequency counts were used to assess how many participants were at each stage of behavior change; low importance/low confidence, high importance/low confidence, low importance/high confidence, and high importance/high confidence—as is proposed by the readiness continuum model of behavior change (van Leer et al., 2008; Miller & Rollnick, 2002). For descriptive purposes, "low" was defined as scores at or below 5, while "high" was defined as scores above 5 on the 10-point scales (1 = *not at all important* to 10 = *extremely important"*).

Preliminary Analyses

Prior to hypothesis testing, all individual variables were screened for normality. Scatterplots were generated between the independent and dependent variables to screen for the multiple regression assumption of linearity. Pearson's bivariate correlations were conducted to determine zero-order relationships between model variables: motivation for healthy eating; availability of healthy and unhealthy food retailers; proportion of healthy food retailers; daily servings of vegetables; daily frequency of fruits and fruit juices; and daily servings of fats and oils, sweets, and sodas (see Figure 5 for primary analysis model). Relevant demographic characteristics, such as parent age and income status, were examined as possible covariates.

Figure 5

Moderation Model of Motivation and the Food Environment on Eating Behavior



Note. The proposed moderation model for the current study's primary hypotheses.

Moderation Analyses

To test Hypotheses 3a and 3b, cross-sectional moderation analyses, using PROCESS (Model 1; Hayes, 2017), were conducted to investigate the influence of the food environment on the relationship between motivation and eating behavior. All predictor variables were centered. The main and interactive effects of the food environment (moderator variable), motivation (independent variable), and eating behavior (dependent variable) were examined. Specifically, there was one predictor (motivation for healthy eating), four moderators (the availability of healthy and unhealthy food retailers within two distances), and two outcome variables (healthy and unhealthy eating behaviors), resulting in eight regression analyses testing for moderation. The nature of these interactions was further examined with simple slope analyses, in which the statistical significance of each interaction was probed at different levels of the moderator variable: +*SD* above the mean, the mean, and -*SD* below the mean). Hypotheses 1 and 2, assessing the influence of motivation on eating behavior, were tested by looking at the main effects of the proposed moderation analyses.

The exploratory analyses (testing Hypotheses 3c and 3d) likewise involved moderated regression assessing the influence of the food environment on the relationship between motivation and eating behavior. The only difference lied in the measurement of the moderator variable (the food environment), which used a calculated proportion of healthy to unhealthy food retailers. Specifically, the exploratory analyses consisted of one predictor (motivation for healthy eating), two moderators (the proportion of unhealthy food retailers within two distances), and two outcome variables (healthy and unhealthy eating behaviors), resulting in four regressions analyses testing for moderation. Simple slope analyses were also used to examine the nature of these interactions.

GPower software was used to estimate power for a regression analysis that includes three predictors—two main effects and an interaction term. The power analysis indicated that, for the incremental analysis associated with the interaction term, a sample size of 55 participants would be sufficient to detect a medium-sized effect ($f^2 = .15$) with a power of .80 and an alpha of .05. For the overall regression model, the effect size needed to be larger than medium ($f^2 = .21$) for detection, assuming a power of .80 and an alpha of .05.

Results

Preliminary Analyses

Preliminary analyses were conducted using IBM SPSS Statistics. All study variables were screened for outliers. Three outliers were found across the following variables: motivation, unhealthy eating, and the 2-mile radius unhealthy food environment. There were no outliers among the healthy eating and healthy food environment variables. Outliers were Winsorized by replacing them with the highest value within three standard deviations from the mean. Next, SPSS descriptive statistics were used to test the assumptions of normality and linearity. All variables showed skew and kurtosis values that were within normal ranges (between -2 and +2 for skew, and between -7 and +7 for kurtosis; see Table 3, Hair et al, 2010; Byrne, 2010). Scatterplots generated between the independent variables (i.e., motivation and neighborhood food retailer availability) and dependent variables (i.e., eating behavior) indicated that the assumptions of linearity and homoscedasticity were met. Data was missing for one participant who did not fill out the eating behavior questionnaire (Block Brief 2000 FFQ), resulting in a case removal. The resulting sample size consisted of 55 participations.

Descriptive Analyses

Measures of central tendency were obtained for all study variables (see Table 3).

Table 3

Descriptive Statistics for Study Variables

Variable	*M* (*SD*)	Minimum	Maximum	Skewness (*SD*)	Kurtosis (*SD*)
Motivation	36.62 (3.88)	25.00	40.00	-1.24 (.32)	1.16 (.63)
Importance	19.04 (1.47)	15	20	-1.46 (.32)	1.27 (.63)
Confidence	17.65 (2.80)	10	20	-1.08 (.32)	.24 (.63)
Healthy Eating Behavior	4.75 (3.44)	.31	14.41	1.52 (.32)	1.93 (.63)
Fruit Intake	1.84 (1.42)	.08	6.00	.98 (.32)	.91 (.63)
Vegetable Intake	2.87 (2.56)	.18	9.77	1.59 (.32)	1.91 (.63)
Unhealthy Eating Behavior	2.47 (1.81)	.28	9.75	1.56 (.32)	3.73 (.63)
Fat Intake	81.36 (50.58)	16.36	205.00	1.07 (.32)	.54 (.63)
Sugary Beverage Intake	119.34 (139.47)	.00	452.84	1.44 (.32)	.98 (.63)
Total Calorie Intake	1925.03 (1206.65)	302.06	5232.84	1.26 (.32)	1.43 (.63)
Healthy Food Retailers (.5-mile)	1.38 (1.05)	0	4	.21(.32)	-.68 (.63)
Unhealthy Food Retailers (.5-mile)	8.38 (4.11)	1	21	1.02 (.32)	1.39 (.63)
% Of Unhealthy Food Retailers	.83 (.15)	.5	1	-1.04 (.32)	.74 (.63)
Healthy Food Retailers (2-mile)	24.40 (11.41)	8	54	1.23 (.32)	.34 (.63)
Unhealthy Food Retailers (2-mile)	122.60 (24.04)	51	170	-.40 (.32)	.54 (.63)
% Of Unhealthy Food Retailers	.84 (.06)	.69	.93	-1.08 (.32)	.20 (.63)

Motivation for Healthy Behavior

The predictor variable "motivation" measured participants' perceived level of importance and confidence in eating more fruits and vegetables and living a healthier lifestyle. The variable was a composite of four questions, each given on a 10-point scale, with higher values indicating greater motivation. As seen in Table 3, participants on average reported a high degree of motivation for health behavior change (M = 36.60, SD = 3.88, range = 25-40). Participants rated slightly greater importance for healthy behavior than confidence in enacting healthy habits ($t(55) = -3.75$, $p < .001$, $M(SD)_{\text{importance}}$ = 19.04 (1.47) and $M(SD)_{\text{confidence}}$ = 17.65 (2.80)). However, fifty-four participants fell into the high importance/high confidence stage of behavior change, while one participant fell into the high importance/low confidence stage, as proposed by the readiness continuum model (van Leer et al., 2008; Miller & Rollnick, 2002).

Neighborhood Food Environment

Figures 6 and 7 depict GIS visualizations of the relative densities of healthy and unhealthy food retailers across the Detroit metropolitan area. Kernel density estimations were applied to each food outlet data point, creating a curved surface. Areas with more points (food outlets) nearby reflected higher density estimates and appeared darker on the map. Darker areas indicated a higher probability of a participant having access to a food outlet at that specific location. Lighter areas reflected neighborhoods with fewer and more dispersed food outlets. Per qualitative inspection, the greatest number of healthy and unhealthy food retailers appeared within downtown Detroit, as may be expected within a highly populated urban location. In addition to the downtown area, healthy retailers appeared denser in the west side of Detroit near Dearborn, MI. Aside from a few major hotspots, healthy food retailers appeared more evenly distributed than unhealthy food retailers across the greater Detroit metro area. In comparison to the healthy food retailer map, greater densities were seen for unhealthy food retailers throughout Detroit.

Table 3 shows the number of food retailers relative to the participants' homes. There were approximately eight unhealthy food retailers within a half-mile of each home address (SD = 4.11, range = 0-21). Six percent of the participants had no unhealthy food retailers within a half-mile of their home, while a majority had 5-10 unhealthy food retailers within a half-mile. On average, there were 122 unhealthy food retailers within two miles of their homes (SD = 24.04, range = 51-170). There were far fewer healthy food retailers near the participants' homes, with an average total of one healthy food retailer within a half-mile (SD = 1.05, range = 0-4). Twenty-seven percent of the participants had no healthy food retailers within a half-mile of their homes, while 59% had 1-2 healthy food retailers within a half-mile. On average, there were 24 healthy food retailers within two miles of their home (*SD* = 11.41, range = 8-54).

Figure 6

Density Map of Unhealthy Food Retailers in the Detroit Metro Area

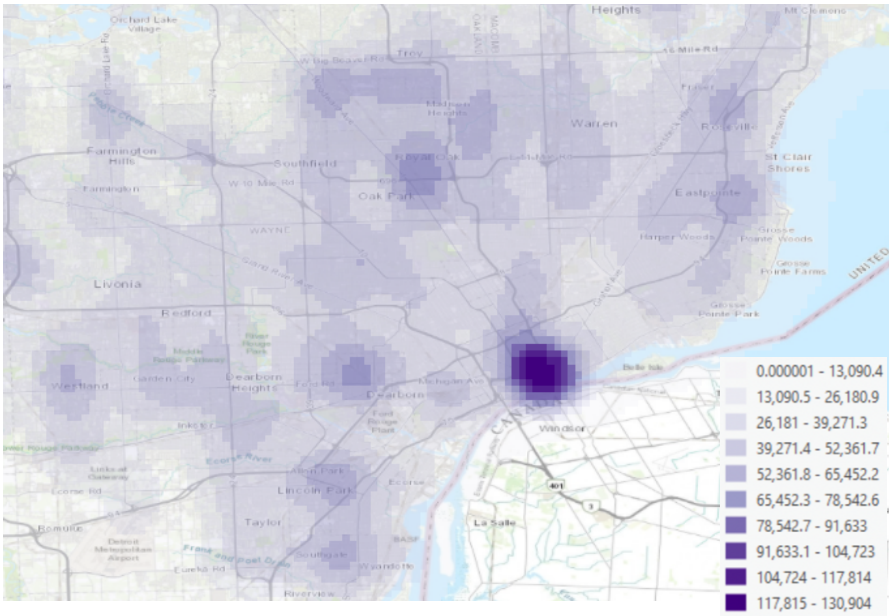
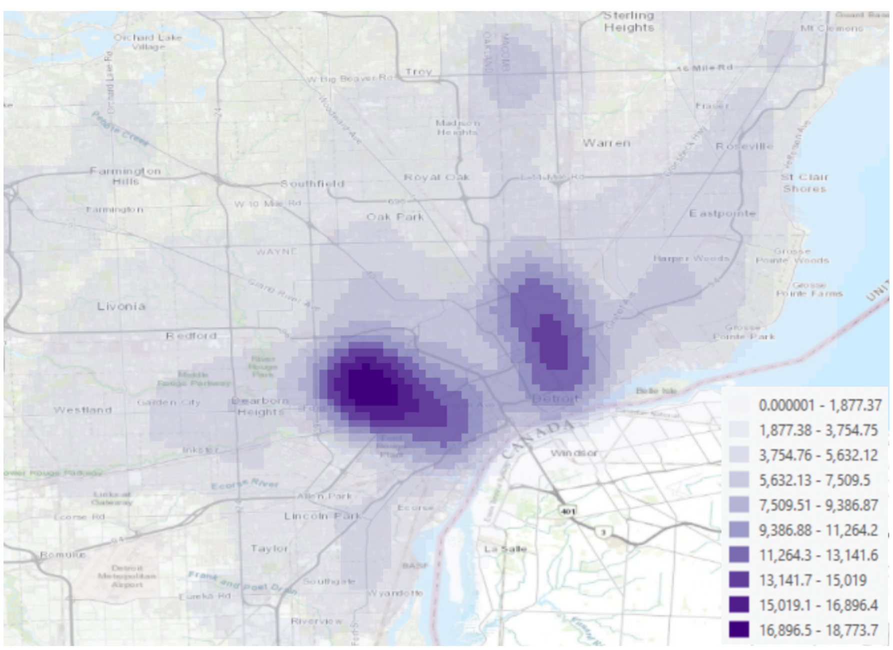


Figure 7

Density Map of Healthy Food Retailers in the Detroit Metro Area



Food accessibility was conceptualized as the proportion of healthy to unhealthy food retailers within one's immediate neighborhood (Table 3). The findings showed that unhealthy retailers were more accessible than healthy retailers by constituting a greater proportion of the neighborhood food environment. Approximately 83% (M = .83, SD = .15, range = .5-1) and 84% (M = .84, SD = .06, range = .69-.93) of food retailers were unhealthy within a ½-mile and 2-mile radius, respectively. The relative proportion of each primary SIC code across all participant neighborhoods can be found in Table 4. Restaurants and convenience stores constituted a majority of the neighborhood food environment within a ½-mile and 2-mile radius. Farmers markets and fruit/vegetable retailers were least common within a 2-mile radius. Grocery stores were the only healthy food retailer type available within a ½-mile radius of each participant's home.

Table 4

Percentage of Primary SIC Descriptions Across Participant Neighborhoods

Variable	***½ Mile Radius***	***2-Mile Radius***
Grocery Stores	14%	14%
Fruits & Vegetable Retail	-	<1%
Farmers Markets	-	<1%
Meat Retailers	-	1.6%
Convenience	26%	24%
Restaurants	49%	49%
Pizza Parlors	8%	8%
Doughnut Shops	1%	1.2%
Ice Cream Parlors	2%	1.5%

Eating Behaviors

Healthy eating behavior was measured by fruit and vegetable intake (Table 3). On average, participants reported eating a total of 4.75 servings of fruits and vegetables per day (SD = 3.44, range = .31-14.41). There was a higher rate of vegetable intake than fruit intake, $t(55)$ =

-3.08, *p* = .003, $M(SD)_{\text{vegetable}}$ = 2.91 (2.68) and $M(SD)_{\text{fruit}}$ = 1.84 (1.42). Healthy eating behavior was more commonly reported than unhealthy eating behavior, *t*(55) = -5.27, *p* < .001, with participants eating a reported average of 2.47 servings of fats, oils, sweets, and sodas per day (*SD* = 1.81, range = .28-9.75). Of this amount, approximately 81.36 calories were derived from daily fat intake (*SD* = 50.58, range = 16.36-205.00) and 119.34 calories were derived from daily sugary beverage intake (*SD* = 139.47, range = 0-452.84). Taken together, participants consumed an average total of 1935.03 calories per day—although, it varied greatly between participants (*SD* = 1206.65, range = 302.06-5232.84).

Correlational Analyses

Pearson r bivariate correlations were used to examine the associations among variables. First, participant demographic characteristics (e.g., age, annual household income, and perceived health level) were examined in relation to the study variables. A negative correlation was found between household income and total calorie intake (*r* = -.30, *p* = .03). The higher the annual income reported, the lower the calorie intake. No other relationships were found significant among the demographics and study variables.

Correlational findings among the primary study variables are depicted in Table 5. When examining the outcome variable, there was a positive correlation between healthy eating behavior and unhealthy eating behavior (*r* = .39, *p* = .004). Within the eating behavior composites, fruit and vegetable intake were positively correlated (*r* = .36, *p* = .007), as well as fat and sugary beverage intake (*r* = .58, *p* < .001). Fat intake was also positively correlated with vegetable intake (*r* = .28, *p* = .04), but not with fruit intake. Sugary beverage intake was not significantly correlated to either fruit or vegetable intake.

Next, bivariate correlations were used to test Hypothesis 1, which posited that motivation for healthy eating would be positively related to healthy eating behavior and negatively related to unhealthy eating behavior. While motivation was not significantly correlated with the healthy and unhealthy eating behavior composites, it was negatively correlated with sugary beverage intake (r = -.34, p = .01) and marginally correlated with fat intake (r = -.25, p = .06). Those participants who reported higher motivation also reported lower sugary beverage intake and fat intake. Within the motivation composite variable, importance and confidence were positively correlated with one another (r = .42, p = .001), in addition to each being negatively correlated with sugary beverage intake ($r_{\text{importance}}$ = -.29, p = .03; $r_{\text{confidence}}$ = -.31, p = .02, respectively). Importance for healthy eating, but not confidence, was negatively correlated to fat intake (r = -.30, p = .03). Motivation, importance, and confidence were not significantly associated with fruit intake or vegetable intake.

Hypothesis 2 posited that the food environment would be related to eating behavior. Contrary to what was hypothesized, food availability (food retailer count) and accessibility (proportion of healthy to unhealthy food retailers) were not significantly related to healthy or unhealthy eating behavior at either distance. When the eating behavior composites were segregated into separate variables, marginal trends were found between sugary beverage intake and the amount and proportion of unhealthy food retailers at the ½-mile radius ($r_{\text{availability}}$ = .23, p = .09; $r_{\text{accessibility}}$ = .24, p = .07). These correlations showed that participants reported marginally greater sugary beverage intake in areas with more unhealthy food retailers. The food environment was not significantly correlated with fruit, vegetable, and fat intake.

Table 5

Correlations Among Study Variables

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1. Motivation	--															
2. Importance	.74**	--														
3. Confidence	.92**	.42**	--													
4. Healthy Eating	.13	.09	.13	--												
5. Fruit Intake	.11	.06	.10	.68**	--											
6. Vegetable Intake	.11	.08	.12	.92**	.36**	--										
7. Unhealthy Eating	-.18	-.15	-.18	.39**	.20	.35**	--									
8. Fat Intake	-.25+	-.30*	-.19	.33*	.21	.28*	.97**	--								
9. Sugary Beverages Intake	-.34*	-.29*	-.31*	.12	.13	.08	.59**	.58**	--							
10. Total Calorie Intake	-.26	-.26	-.22	.60**	.35**	.57**	.78**	.77**	.65**	--						
11. Healthy Food Retailers (.5-mile)	.16	.12	.13	-.06	.13	-.15	.05	.07	-.10	-.10	--					
12. Unhealthy Food Retailers (.5-mile)	.05	.05	.02	-.12	.03	-.16	.03	.10	.23+	.03	.45**	--				
13. % Of Unhealthy Food Retailers (.5-mile)	-.16	-.13	-.14	-.11	-.08	-.07	-.11	-.04	.24+	-.05	-.44**	.40**	--			
14. Healthy Food Retailers (2-mile)	.18	.10	.19	-.02	.16	-.11	-.13	-.13	-.07	-.14	.17	-.03	-.29*	--		
15. Unhealthy Food Retailers (2-mile Radius)	.19	.07	.23	.002	-.01	.004	-.07	-.08	.004	-.07	.10	.19	.02	.27*	--	
16. % Of Unhealthy Food Retailers (2-mile)	-.11	-.09	-.09	.01	-.16	.10	.10	.10	.09	.12	-.16	.10	.30*	-.89**	.16	--

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

+. Correlation is marginally significant at the 0.10 level (2-tailed).

Moderation Analyses

A series of moderated regression analyses were conducted to test Hypothesis 3. Hypotheses 3a and 3b posited that the relation between motivation for healthy eating and actual eating behavior, as measured by the intake of fruits, vegetables, fats, sweets, and soda, would be moderated by food availability. No significant main effects or interactions were found between the proposed study variables (see Tables 6-9). Contrary to Hypothesis 3a, the relation between motivation and healthy eating was not significantly facilitated by food environments with more healthy retailers and less unhealthy retailers at either distance. Likewise, contrary to Hypothesis 3b, the relation between motivation and unhealthy eating was not significantly thwarted by food environments with more healthy retailers and less unhealthy retailers at either distance.

Table 6

Primary Hypotheses 3a and 3b: Moderating Effects of Healthy Food Availability (Within ½ Mile) on the Relation Between Motivation and Eating Behavior

	Healthy Eating Behavior				Unhealthy Eating Behavior			
Predictor	b (SE)	df	*t*-ratio	R^2/R^2 adjusted	b (SE)	df	*t*-ratio	R^2/R^2 adjusted
Intercept	4.81 (.47)**	51	10.17		2.52 (.24)**	51	10.36	
Motivation	.42 (.48)	51	.88		-.40 (.24)	51	-1.63	
Healthy Food Retailers (.5-mile)	-.25 (.47)	51	-.53		.17 (.24)	51	.68	
Motivation X Healthy Food Retailers (.5-mile)	-.42 (.47)	51	-.90	.19/.02	-.36 (.24)	51	-1.51	.28/.04

Note. $^{**}p < .01$; $^{*}p < .05$.

Table 7

Primary Hypotheses 3a and 3b: Moderating Effects of Unhealthy Food Availability (Within ½ Mile) on the Relation Between Motivation and Eating Behavior

	Healthy Eating Behavior				Unhealthy Eating Behavior			
Predictor	b (SE)	df	*t*-ratio	R^2/R^2 adjusted	b (SE)	df	*t*-ratio	R^2/R^2 adjusted
Intercept	4.77 (.46)**	51	10.22		2.47 (.24)**	51	10.06	
Motivation	.49 (.47)	51	1.05		-.31 (.24)	51	-1.27	
Unhealthy Food Retailers (.5-mile)	-.43 (.47)	51	-.92		-.06 (.24)	51	.27	
Motivation X Unhealthy Food Retailers (.5-mile)	-.40 (.46)	51	-.87	.21/.01	-.16 (.24)	51	-.65	.20/.008

Note. $^{**}p < .01$; $^{*}p < .05$.

Table 8

Primary Hypotheses 3a and 3b: Moderating Effects of Healthy Food Availability (Within 2 Miles) on the Relation Between Motivation and Eating Behavior

	Healthy Eating Behavior				Unhealthy Eating Behavior			
Predictor	b (SE)	df	*t*-ratio	R^2/R^2 adjusted	b (SE)	df	*t*-ratio	R^2/R^2 adjusted
Intercept	4.94 (.48)**	51	10.38		2.45 (.25)**	51	9.66	
Motivation	.18 (.51)	51	.35		-.25 (.27)	51	-.95	
Healthy Food Retailers (2-mile)	.21 (.52)	51	.39		-.22 (.28)	51	-.78	
Motivation X Healthy Food Retailers (2-mile)	-1.04 (.65)	51	-1.60	.26/.05	.11 (.34)	51	.33	.21/.002

Note. $^{**}p < .01$; $^{*}p < .05$.

Table 9

Primary Hypotheses 3a and 3b: Moderating Effects of Unhealthy Food Availability (Within 2 Miles) on the Relation Between Motivation and Eating Behavior

	Healthy Eating Behavior				Unhealthy Eating Behavior			
Predictor	b (SE)	df	*t*-ratio	R^2/R^2 adjusted	b (SE)	df	*t*-ratio	R^2/R^2 adjusted
Intercept	4.92 (.47)**	51	10.41		2.55 (.25)**	51	10.30	
Motivation	.27 (.49)	51	.55		-.41 (.26)	51	-1.60	
Unhealthy Food Retailers (2-mile)	.17 (.50)	51	.33		.06 (.26)	51	.24	
Motivation X Unhealthy Food Retailers (2-mile)	-.90 (.55)	51	-1.64	.26/.05	-.44 (.29)	51	-1.51	.27/.04

Note. $^{**}p < .01$; $^{*}p < .05$.

Further exploratory analyses (Hypotheses 3c and 3d) measured the food environment by the proportion of healthy to unhealthy retailers (see Tables 10 and 11). Contrary to Hypothesis 3c, the relation between motivation and healthy eating (fruit & vegetable intake) was not significantly thwarted by food environments with a greater proportion of unhealthy retailers at either distance. Hypothesis 3d, on the other hand, examined this model using unhealthy eating behavior as the outcome variable. It posited that the influence of motivation on unhealthy eating behavior (fat, oil, sweets, and soda intake) would be mitigated by the proportion of unhealthy food retailers. This was tested at two distances (1/2-mile and 2-mile).

Using the ½-mile radius, the overall model predicted unhealthy eating behavior with marginal significance, $R^2 = .13$, $F(3, 51) = 2.46$, $p = .07$ (see Table 10). Results indicated that greater motivation (b= -.53, $t(51) = -2.11$, $p = .03$) was associated with less unhealthy eating behavior. The proportion of unhealthy food retailers did not independently predict unhealthy eating behavior, $b = -.28$, $t(51) = -1.18$, $p = .24$. However, the interaction between motivation and the proportion of unhealthy food retailers (within a ½-mile) was significant, $b = .59$, $t(51) = 2.07$, $p = .04$, suggesting that the effect of motivation on unhealthy eating behavior depended on the proportion of healthy to unhealthy food retailers within one's neighborhood. The nature of this interaction was further examined with a simple slopes test (see Figure 8), which assessed the statistical significance of the interaction at different levels of the moderator variable: high (+1 *SD* above mean), average (mean), and low (-1 *SD* below mean) proportions of unhealthy food retailers. The test revealed a significant negative association for the low condition ($b = -.88$, $p = .01$). Since the percentage of unhealthy food retailers ranged from 50% to 100% across neighborhoods, this finding indicated that participants who reported high motivation ate fewer unhealthy foods when there was relatively equal access to nearby unhealthy and healthy food retailers. No further slopes were significant, indicating that the interactions lost significance as the proportion of unhealthy food retailers increased. No significant main effects and interactions were found at the 2-mile distance (see Table 11).

Further steps were taken to comprehensively examine the data by dividing the motivation composite and eating behavior composites into separate variables (e.g., importance, confidence, fruit, vegetable, fat, and sugary beverage intake). This did not result in any significant main effects or interactions.

Table 10

Exploratory Hypotheses 3c and 3d: Moderating Effects of Unhealthy Food Accessibility (Within ½ Mile) on the Relation Between Motivation and Eating Behavior

	Healthy Eating Behavior				Unhealthy Eating Behavior			
Predictor	b (SE)	df	*t*-ratio	R^2/R^2 adjusted	b (SE)	df	*t*-ratio	R^2/R^2 adjusted
Intercept	4.78 (.48)**	51	9.97		2.57 (.24)**	51	10.72	
Motivation	.35 (.51)	51	.68		-.53 (.25)*	51	-2.11	
% of Unhealthy Food Retailers (.5-mile)	-.33 (.48)	51	-.69		-.28 (.24)	51	-1.18	
Motivation X % of Unhealthy Food Retailers (.5-mile)	.18 (.57)	51	.33	.17/.002	.59 (.28)*	51	2.07	.36/.07

Note. ***p* < .01; **p* < .05.

Table 11

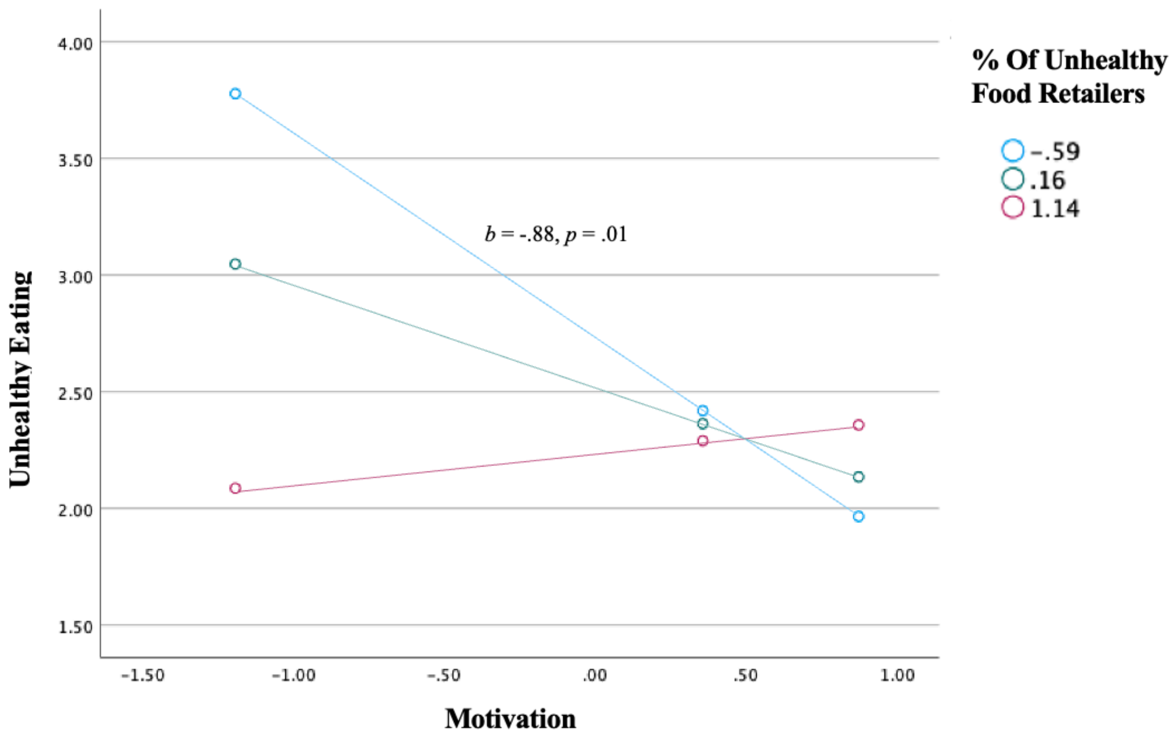
Exploratory Hypotheses 3c and 3d: Moderating Effects of Unhealthy Food Availability (Within 2 Miles) on the Relation Between Motivation and Eating Behavior

	Healthy Eating Behavior				Unhealthy Eating Behavior			
Predictor	b (SE)	df	*t*-ratio	R^2/R^2 adjusted	b (SE)	df	*t*-ratio	R^2/R^2 adjusted
Intercept	4.81 (.47)**	51	10.14		2.44 (.25)**	51	9.90	
Motivation	.36 (.49)	51	.72		-.24 (.26)	51	-.96	
% of Unhealthy Food Retailers (2-mile)	-.03 (.50)	51	-.05		.22 (.26)	51	.84	
Motivation X % of Unhealthy Food Retailers (2-mile)	.52 (.61)	51	.85	.18/.01	-.32 (.32)	51	-1.01	.24/.02

Note. ***p* < .01; **p* < .05.

Figure 8

Interaction Between Motivation and Unhealthy Food Accessibility as Predictors of Unhealthy Eating Behavior



Discussion

While the etiologies of obesity and weight gain are multifaceted and complex, there are significant disparities in eating behavior that favor high-energy and low-nutrient foods among low-income and marginalized racial/ethnic groups (Darmon & Drewnowski, 2015). Numerous public health initiatives have tried to promote better health by increasing knowledge and motivation for healthy eating but have largely fallen short in their ability to create meaningful and lasting change (Leung et al., 2017). Thus, the current study utilized an ecological systems approach to examine the respective influences of motivation and the neighborhood food environment on eating behavior. The food environment was further examined as a moderator of the intention-behavior gap, to better understand the barriers precluding individuals from translating their dietary health goals into achievement. Understanding the interplay of individual- and macro-level factors on eating behavior, in a sample of economically marginalized African American women, is critical to curtailing the disparities seen in weight gain and obesity.

Participant Eating Behaviors

The dietary intake of our sample was somewhat consistent with national recommendations. The American Heart Association (AHA, 2017), for example, recommends 4-5 servings of fruits and vegetables per day. Although our study showed highly variable self-reported food intake, most participants reported eating the recommended daily servings of fruits and vegetables. Moreover, added sugars and fats should compose less than 10% of one's daily calorie intake according to the *2015-2020 Dietary Guidelines for Americans (DGA)*. On average, the participants in our sample obtained the recommended proportion of calories from fats and oils. Overall, participants consumed an average total of 1935.03 calories per day, which was comparable to the *DGA* estimated calorie needs of 1,600-2,400 calories/day for adult women. Importantly, this value greatly varied between participants, with some reporting less than a quarter or double the estimated calorie needs. While healthy eating behavior was more commonly reported than unhealthy eating behavior in our sample, a detailed examination of individual variation showed many deviations from national recommendations.

Factors Influencing Eating Behavior

The current study examined participant motivation for healthy eating and the neighborhood food environment as potential predictors of eating behavior. Conclusions obtained from each respective variable, as well as interactions between the two, are discussed below.

Participant Motivation

Hypothesis 1 posited that motivation would be positively related to healthy eating behavior and negatively related to unhealthy eating behavior. In contrast, our results did not show a significant relationship between motivation and overall healthy or unhealthy eating composites. However, a more fine-grained analysis found that high motivation for healthy living was associated with less sugary beverage consumption. This is in line with past research that has suggested that motivational interventions can reduce daily sugary beverage consumption among individuals who frequently drink and crave sugary beverages (Mason et al., 2021). To a lesser degree, motivation was also associated with eating fewer fatty foods. Past research has shown that motivation can decrease dietary fat intake, but that this relation is mediated through perceived self-efficacy (Chang et al., 2020). Accordingly, the participants in our sample reported lower confidence in their ability to eat fewer fatty foods. Motivation was not significantly related to any other individual dietary variables (e.g., fruit and vegetable intake).

Several possibilities may explain these mixed findings. For example, there are difficulties with documenting what individuals consume as their typical diet due to dietary measurement errors (Ravelli & Schoeller, 2020). As a result, traditional self-reported dietary instruments often show inconsistencies with quantitative biomarkers of dietary intake (Ravelli & Schoeller, 2020). Most notably, the consumption of key foods and beverages may be missed if the questionnaire's pre-specified list inappropriately suits the target population (Grummon et al., 2018). Further inaccuracies may arise from participant errors in capturing portion size and intake frequency. The current study utilized a longer referent period, in which participants were asked to recall their intake over the past month. This may have inadvertently decreased accuracy for the benefit of reducing participation burden. It is also more difficult to assess the intake of items that are consumed in mixtures, which tends to be more problematic for assessing foods than beverages (Grummon et al., 2018). Since sugary beverages are generally consumed as single items, they may be easier for participants to recall and quantify and, as a result, more accurately reflect their actual dietary intake. This may explain why the strongest relationship between motivation and eating behavior was found specifically for sugary beverage intake.

Alternatively, the otherwise null findings may be reflective of the intention-behavior gap, which captures the frequent inability to translate strong goal intentions to achievement. For example, a meta-analysis of experimental data found that a substantial increase in intention is needed to produce a minor increase in the desired behavior, while others indicate that many people ultimately fall back on old habits (Anderson et al., 2019; Sheeran & Webb, 2016). From our sample, 98% participants fell into the high importance and high confidence stage of behavior change on the readiness continuum model, meaning they reported being highly motivated to eat healthfully and confident in their ability to do so. Despite this, eating behaviors were not in line with national guidelines, with most participants eating fewer fruits and vegetables and greater amounts of saturated and unsaturated fats than what is recommended. This suggests that motivation alone may not be enough to encourage healthy eating, and it provides further justification for studying the moderators of the intention-behavior gap, to shed light on the factors impeding goal achievement.

Perceived motivation within our sample was also consistently high with somewhat limited variability, which could have further contributed to the non-significant relationships found between motivation and overall eating behavior composites. The current study utilized participants recruited into a larger study geared toward building healthier lifestyles, and thus, it is understandable that baseline reports of motivation may be higher than the general population.

Although participants reported high motivation overall, there was some variance that came primarily from participants who reported lower confidence in their ability to enact healthy eating habits, despite acknowledging the importance of eating better. Social desirability bias may also have influenced the elevated motivation scores seen in our sample.

Neighborhood Food Environment

Healthy and unhealthy food retailers within Detroit, Michigan, were examined to capture the effects of “food deserts” (areas with limited healthy food outlets) and “food swamps” (areas with abundant unhealthy food outlets) on eating behavior. First, food outlets were visualized through GIS techniques to gauge the spatial patterning of healthy and unhealthy food sources across the Detroit metropolitan area. Overall, unhealthy food retailers were less evenly distributed than healthy retailers across neighborhoods, although both showed pronounced clusters across neighborhoods. As may be expected, healthy and unhealthy outlets were most frequently allocated in highly populated inner-city locations.

Our participant sample resided throughout Detroit, thereby capturing the effects of higher and lower density areas. A majority of our sample had at least one healthy food retailer within a walking distance from their home, as well as multiple healthy options within a driving distance. Unhealthy food retailers, on the other hand, predominated neighborhood food environments. This suggests that, while there may be unequal geographical access to healthy and unhealthy food sources across Detroit, it is misleading to call the city a “food desert.” In line with previous findings, urban environments appear to be better characterized as “food swamps” than “food deserts” (Reel & Badger, 2014). Using the sole presence of supermarkets and grocery stores to study food access is likely to ignore many important venues from which people obtain food (Taylor & Ard, 2015).

Hypothesis 2 posited that characteristics of the food environment would be related to eating behavior. Specifically, the food environment was theorized to influence eating behavior through one of two mechanisms: (a) geographical availability representing the number of healthy and unhealthy food retailers per neighborhood or (b) geographical accessibility representing the proportion of healthy to unhealthy food retailers within one's neighborhood to address the potential impact of environmental food cues on eating behavior. Contrary to what was hypothesized, the food environment did not independently predict eating behavior. There were only marginal trends at the ½-mile radius, suggesting that participants may be inclined to drink more sugary beverages when there is a greater number and proportion of unhealthy food retailers within their proximate environment. While past research has reached mixed conclusions about the food environment's impact on eating behavior (Odoms-Young et al., 2016), most agree that that the etiologies of weight gain are complex and multi-faceted. Thus, the goal of the current study was to examine the interplay of individual-level and macro-level factors on eating behavior.

Interplay Between Motivation, Eating Behavior, and Food Availability/Accessibility

Despite the widely accepted theoretical existence of the intention-behavior gap, little is known about the moderating factors that contribute to its discrepancy. As a result, the primary objective of this study was to examine environmental moderators of the intention-behavior gap. Specifically, this study examined how motivation for healthy eating predicts actual eating behavior in the context of food availability and accessibility. Characteristics of the food environment, as they relate to the availability and accessibility of various food retailers, were hypothesized to moderate the relation between participants' motivation for healthy eating and their actual intake of fruits, vegetables, fats, sweets, and sodas.

Food Accessibility. Hypothesis 3d posited that the relation between motivation and unhealthy eating behavior would be moderated by food accessibility (measured by the proportion of healthy to unhealthy retailers within one's neighborhood). In accordance, our results found that greater motivation was associated with less unhealthy eating when there was relatively equal access to nearby unhealthy and healthy food retailers. When given both options, in the context of high motivation, individuals may be more likely to decline unhealthy foods consisting of high amounts of oils, fats, and sugars. However, motivation did not significantly impact eating behavior when there was a significantly greater proportion of unhealthy food retailers in the participants' neighborhoods. Living in a highly obesogenic environment with a substantially greater proportion of unhealthy retailers may overwhelm the protective effects of having nearby healthy food options, even in the context of high motivation for healthy eating. Preexisting research has shown that food cues (e.g., the sight or smell of food) can invoke a conditioned response such as hunger, cravings, and salivation (Morys et al., 2020). When exposed to a food cue, highly motivated individuals may seek out healthier food options. However, if the unhealthy options are more salient than the healthy ones, even motivated individuals may succumb to their temptations and choose the most convenient option.

Importantly, only unhealthy eating behaviors were predicted by the interplay of motivation and food accessibility. Contrary to Hypothesis 3c, having access to healthy food options in the neighborhood did not increase fruit and vegetable intake, even in the context of high motivation. This may be due to the high costs of fresh fruits and vegetables. Accordingly, studies have shown that dietary costs constrain the diet quality of low-income individuals by reducing fruit and vegetable intake (Mackenbach et al., 2019). While "food deserts" emphasize supermarket/grocery store availability as the main limitation to a healthy diet, the cost of high-quality perishable foods likely poses an additional barrier.

Moreover, the interaction between motivation, food retailer accessibility, and eating behavior was only significant at the ½ mile radius, suggesting that one's immediate environment plays a more influential role than one's distant environment on eating behavior. It may be that participants are exposed to more unhealthy environmental food cues (e.g., fast food logos, advertisements, and promotions) when unhealthy food outlets predominate their immediate environment. The low-income women in our sample may also have less resources (e.g., time and transportation) to shop outside of their immediate environment to find affordable healthy food options. Accordingly, preexisting literature has shown that residents who rely on their immediate neighborhood food environment have a higher likelihood of being overweight/obese than those who do not utilize the stores around them (Ledoux et al., 2017).

Food Availability. Hypotheses 3a and 3b posited that the distinct number of food retailers in one's neighborhood would also moderate the relation between motivation for healthy eating and actual eating behavior; however, this was not the case. Only food accessibility moderated this relation, suggesting that the proportion of healthy to unhealthy food retailers within one's neighborhood may be more influential than the mere availability of either type of food outlet. Researchers may need to investigate the concurrent influence of healthy and unhealthy food retailers, rather than the availability of one over another, to fully capture the effects of the food environment on eating behavior. For example, based on the results of this study, one might infer that equal exposure to healthy food outlets can counteract the impact of obesogenic food cues. However, having a nearby grocery store may not be enough to deter fast food consumption if there are several fast-food restaurants tempting the individual along the way.

Study Limitations

There were several limitations to this study that may have hindered our findings. For example, given the cross-sectional nature of our analyses, there was a limited ability to infer causality and direction of influence. Moreover, the statistical power of our analyses was greatly limited by our small sample size of 55 participants. As power decreases, there is a greater risk of obtaining type II errors (missing statistically significant differences when they exist). Moderate effect sizes were needed to detect significance in our sample, suggesting that the results of this study are unlikely to be false positives. Future researchers should examine these interactions using larger sample sizes, as there may be additional significant associations with smaller effect sizes. Even small influences on eating behavior may be meaningful in reducing the disparities seen in weight gain and obesity among low-income African American women.

Participant motivation in our sample was also consistently high, which may decrease the generalizability of our results. As mentioned, our participants were enrolled in a larger intervention geared towards healthy behavior change, and their voluntary participation may have created a selection bias favoring highly motivated individuals. Past studies have shown that substantial motivation is needed to yield changes in eating behavior, and thus, it is possible that the results may not extend to individuals who are less motivated or feel indifferent about their eating behavior. With that being said, the findings of this study provide useful insights into why some motivational interventions may yield inconsistent and short-lasting changes on eating behavior (Faries, 2016), even after substantially increasing participant motivation for change.

Further limitations are tied to the difficulty of measuring the neighborhood food environment. At current, there is no methodological gold standard for characterizing obesity-related elements of the built environment (Hughey et al., 2019). Our analyses did not account for the entire food environment an individual may be exposed to throughout the day (e.g., food retailers near one's workplace may also influence eating behaviors). Examining these relationships using subjective perceptions of food availability and accessibility may be a better reflection of their actual lived experiences. Likewise, categorizing food outlets as being either healthy or unhealthy may inaccurately reflect the quality and quantity of individual purchases. Grocery stores and supermarkets, in particular, offer a wide array of healthy and unhealthy foods. In such cases, food prices and personal preferences may impart more influence on eating choices. Future researchers should examine food retailers in more detailed and nuanced ways, considering the types of foods that are available in the stores and how they are displayed, advertised, and priced. Santarossa and colleagues, for example, recommend examining five dimensions of food access (access, availability, affordability, acceptability, and accommodation (2021). The current study did not account for each food retailers' affordability, sociocultural acceptability, or accommodation (e.g., flexible hours or acceptance of food stamps).

Lastly, transportation mode was not controlled for in this study. Although two distances were utilized to account for different modalities of travel (e.g., walking and driving), it is unclear whether our participants typically walk, drive, or use public transportation to get food. Different modalities of travel impact the breadth of one's food environment and impose additional barriers when increased effort and travel time are required. Future researchers should consider controlling for vehicle ownership when estimating travel distances.

Study Strengths

Despite the above limitations, the current study had many strengths. GIS methods provide a cost- and time-efficient approach to analyzing the food environment that are widely utilized by local authorities, government agencies, and town planners in establishing policies and developing infrastructure (Glanz et al., 2016). Thus, it is important to validate GIS methods in their ability to predict health outcomes. Since the preexisting food environment literature has focused predominantly on larger scale designs (e.g., correlating city-level eating trends with city-level food retailer data), the current study presented a unique opportunity to link GIS data directly to individual-level health data. Doing so, allowed for a more fine-grained analysis, in which individual-level factors, such as motivation for healthy eating, could be incorporated into our understanding of eating behavior in the context of food accessibility/deprivation. Moreover, steps were taken to address endogeneity by measuring a much wider selection of food outlets than what has been typically seen in the preexisting literature. The current study showed that examining the effects of healthy and unhealthy food outlets concurrently may be important to capture the full effects of the food environment on health outcomes.

Most significantly, the current study addressed a substantial gap in the literature by examining moderators of the intention-behavior gap. Multiple authors have advised contemporary researchers to apply moderation and mediation models to their investigations of the intention-behavior gap (Black & Macinko, 2008; Rhodes & Dickau, 2012). Despite this, only a minority of preexisting research has examined moderators of the intention-behavior gap in the context of eating behavior, and those that have are focused exclusively on internal and individual-level moderators. No other study, to our knowledge, has looked at environmental moderators of the intention-behavior gap, such as food accessibility and deprivation, in the context of eating behavior. This lack of insight particularly extends to low-income minority women who are most susceptible to unhealthy eating and often face additional contextual barriers when trying to translate their intentions into behaviors.

Implications

The current study contributes to a growing body of literature on the intention-behavior gap and highlights the importance of examining associations between individual-level and macro-level factors on food consumption. Our results show that inequities in the neighborhood food environment can influence diet-related public health outcomes in complex and nuanced ways. This may be especially and disproportionately impactful on low income and marginalized communities. Public health interventions may require a multifaceted approach to instill meaningful and long-lasting change in eating behavior and weight-related outcomes. A combination of motivational interviewing interventions along with innovative food policy and urban planning initiatives may be particularly helpful in promoting healthier communities.

References

Abraham, C., & Sheeran, P. (2003). Acting on intentions: The role of anticipated regret. *British Journal of Social Psychology*, *42*(4), 495-511. https://doi.org/10.1348/014466603322595248

Airhihenbuwa, C. O., Kumanyika, S., Agurs, T. D., Lowe, A., Saunders, D., & Morssink, C. B. (1996). Cultural aspects of African American eating patterns. *Ethnicity & Health*, *1*(3), 245-260. https://doi.org/10.1080/13557858.1996.9961793

Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes*, *50*(2), 179-211. https://doi.org/10.1016/0749-5978(91)90020-T

Almadan, A. H. (2015). *Utilizing geographic information systems to examine the demographic and socioeconomic characteristics in food oasis and food desert in Wayne County, MI.* [Doctoral dissertation, Eastern Michigan University]. Master's Theses and Doctoral Dissertations. https://commons.emich.edu/theses/676

Alwarawrah, Y., Kiernan, K., & MacIver, N. J. (2018). Changes in nutritional status impact immune cell metabolism and function. *Frontiers in Immunology*, *9*, 1055. https://doi.org/10.3389/fimmu.2018.01055

American Heart Association. (2017). *Fruits and vegetables serving sizes infographic.* https://www.heart.org/en/healthy-living/healthy-eating/add-color/fruits-and-vegetables-serving-sizes

Amireault, S., Godin, G., Vohl, M. C., & Pérusse, L. (2008). Moderators of the intention-behaviour and perceived behavioural control-behaviour relationships for leisure-time physical activity. *International Journal of Behavioral Nutrition and Physical Activity*, *5*(1), 7. https://doi.org/10.1186/1479-5868-5-7

Anderson, Y. C., Dolan, G. M., Wynter, L. E., Treves, K. F., Wouldes, T. A., Grant, C. C., Cave, T. L., Smiley, A. J., Derraik, J. G. B., Cutfield, W.S., & Hofman, P. L. (2019). Caregiver's readiness for change as a predictor of outcome and attendance in an intervention programme for children and adolescents with obesity: A secondary data analysis. *BMJ Open*, *9*(3), e023195. http://dx.doi.org/10.1136/bmjopen-2018-023195

Antin, T. M., & Hunt, G. (2012). Food choice as a multidimensional experience. A qualitative study with young African American women. *Appetite*, *58*(3), 856-863. https://doi.org/10.1016/j.appet.2012.01.021

Armitage, C. J., & Conner, M. (2001). Efficacy of the theory of planned behaviour: A meta-analytic review. *British Journal of Social Psychology*, *40*(4), 471-499. https://doi.org/10.1348/014466601164939

Armstrong, M. J., Mottershead, T. A., Ronksley, P. E., Sigal, R. J., Campbell, T. S., & Hemmelgarn, B. R. (2011). Motivational interviewing to improve weight loss in overweight and/or obese patients: A systematic review and meta-analysis of randomized controlled trials. *Obesity Reviews. 12*(9):709–23. https://doi.org/10.1111/j.1467-789X.2011.00892.x

Azami, S., Nourizadeh, R., Mehrabi, E., Poursharifi, H., & Farshbaf-Khalili, A. (2020). Effect of motivational interviewing on dietary intake and weight changes among preconception women with overweight and obesity: A randomized controlled trial. *Crescent Journal of Medical and Biological Sciences*, *7*, 260-266. ISSN: 2148-9696

Barrett, S., Begg, S., O'Halloran, P., & Kingsley, M. (2018). Integrated motivational interviewing and cognitive behaviour therapy for lifestyle mediators of overweight and obesity in community-dwelling adults: a systematic review and meta-analyses. *BMC Public Health*, *18*(1), 1-10. https://doi.org/10.1186/s12889-018-6062-9

Berrigan, D., Dodd, K., Troiano, R. P., Krebs-Smith, S. M., & Barbash, R. B. (2003). Patterns of health behavior in US adults. *Preventive Medicine*, *36*(5), 615-623. https://doi.org/10.1016/S0091-7435(02)00067-1

Black, J. L., & Macinko, J. (2008). Neighborhoods and obesity. *Nutrition Reviews*, *66*(1), 2-20. https://doi.org/10.1111/j.1753-4887.2007.00001.x

Blisard, W. N., & Jolliffe, D. (2006). *Let's eat out: Americans weigh taste, convenience and nutrition* (No. 19). United States Department of Agriculture. https://www.ers.usda.gov/publications/pub-details/?pubid=44119

Bliss, E. S., & Whiteside, E. (2018). The gut-brain axis, the human gut microbiota and their integration in the development of obesity. *Frontiers in Physiology, 9*, 900. https://doi.org/10.3389/fphys.2018.00900

Block, D., & Kouba, J. (2006). A comparison of the availability and affordability of a market basket in two communities in the Chicago area. *Public Health Nutrition*, *9*(7), 837-845. https://doi.org/10.1017/PHN2005924

Block, G., Hartman, A. M., Dresser, C. M., Carroll, M. D., Gannon, J., & Gardner, L. (1986). A data-based approach to diet questionnaire design and testing. *American Journal of Epidemiology, 124*(3), 453-469. https://doi.org/10.1093/oxfordjournals.aje.a114416

Block, G., Hartman, A., & Naughton, D. (1990). A Reduced Dietary Questionnaire: Development and Validation. *Epidemiology, 1*(1), 58-64. Retrieved from http://www.jstor.org/stable/20065625

Blüher, M. (2019). Obesity: Global epidemiology and pathogenesis. *Nature Reviews Endocrinology*, *15*(5), 288-298. https://doi.org/10.1038/s41574-019-0176-8

Blum, K., Thanos, P. K., & Gold, M. S. (2014). Dopamine and glucose, obesity, and reward deficiency syndrome. *Frontiers in Psychology*, *5*, 919. https://doi.org/10.3389/fpsyg.2014.00919

Briggs, A. C., Black, A. W., Lucas, F. L., Siewers, A. E., & Fairfield, K. M. (2019). Association between the food and physical activity environment, obesity, and cardiovascular health across Maine counties. *BMC Public Health, 19*(1), 1-9. https://doi.org/10.1186/s12889-019-6684-6

Brown, C., & Borisova, T. (2007, October). *Understanding commuting and grocery shopping using the American Time Use Survey* [Conference Session]. International Association of Time Use Research XXIX Conference. http://www.atususers.umd.edu/wip2/papers_i2007/CBrown.pdf

Brug, J. (2008). Determinants of healthy eating: Motivation, abilities and environmental opportunities. *Family Practice*, *25*(suppl_1), i50-i55. https://doi.org/10.1093/fampra/cmn063

Brug, J., Oenema, A., & Ferreira, I. (2005). Theory, evidence and Intervention Mapping to improve behavior nutrition and physical activity interventions. *International Journal of Behavioral Nutrition and Physical Activity*, *2*(1), 1-7. https://doi.org/10.1186/1479-5868-2-2

Brunkwall, L., Chen, Y., Hindy, G., Rukh, G., Ericson, U., Barroso, I., Johansson, I., Franks, P.W., Orho-Melander, M. and Renström, F. (2016). Sugar-sweetened beverage consumption and genetic predisposition to obesity in 2 Swedish cohorts. *The American Journal of Clinical Nutrition, 104*(3), 809-815. https://doi.org/10.3945/ajcn.115.12605227465381

Buhmann, H., le Roux, C. W., & Bueter, M. (2014). The gut–brain axis in obesity. *Best Practice & Research Clinical Gastroenterology, 28*(4), 559-571. https://doi.org/10.1016/j.bpg.2014.07.003

Byrne, B. M. (2010). Structural equation modeling with AMOS: Basic concepts, applications, and programming. New York: Routledge.

Carlson, S., Rosenbaum, D., Keith-Jennings, B., & Nchako, C. (2016). SNAP works for America's children. *Center for Budget and Policy Priorities*. https://www.cbpp.org/sites/default/files/atoms/files/9-29-16fa.pdf

Caspi, C. E., Sorensen, G., Subramanian, S. V., & Kawachi, I. (2012). The local food environment and diet: A systematic review. *Health & Place*, *18*(5), 1172-1187. https://doi.org/10.1016/j.healthplace.2012.05.006

Catley, D., Grobe, J., Moreno, J. L., Stortz, S., Fox, A. T., Bradley-Ewing, A., Richter, K. P., Resnicow, K., Harris, K. J., & Goggin, K. (2021). Differential mechanisms of change in motivational interviewing versus health education for smoking cessation induction. *Psychology of Addictive Behaviors, 35*(7), 778-787. https://doi.org/10.1037/adb0000720

Center for Evidence-Based Practices at Case Western Reserve University. (2010). *Readiness ruler.* https://www.centerforebp.case.edu/resources/tools/readiness-ruler

Chang, M. W., Tan, A., Ling, J., Wegener, D. T., & Robbins, L. B. (2020). Mediators of intervention effects on dietary fat intake in low-income overweight or obese women with young children. *Appetite, 151,* 104700. https://doi.org/10.1016/j.appet.2020.104700

Charreire, H., Casey, R., Salze, P., Simon, C., Chaix, B., Banos, A., Badariotti, D., Weber, C., & Oppert, J. M. (2010). Measuring the food environment using geographical information systems: A methodological review. *Public Health Nutrition*, *13*(11), 1773-1785. https://doi.org/10.1017/S1368980010000753

Chen, X. (2017). Take the edge off: A hybrid geographic food access measure. *Applied Geography, 87,* 149-159. https://doi.org/10.1016/j.apgeog.2017.07.013

Chung, C., & Myers Jr, S. L. (1999). Do the poor pay more for food? An analysis of grocery store availability and food price disparities. *Journal of Consumer Affairs*, *33*(2), 276-296. https://doi.org/10.1111/j.1745-6606.1999.tb00071.x

Conner, M., McEachan, R., Lawton, R., & Gardner, P. (2016). Basis of intentions as a moderator of the intention–health behavior relationship. *Health Psychology*, *35*(3), 219. https://doi.org/10.1037/hea0000261

Cooksey-Stowers, K., Schwartz, M. B., & Brownell, K. D. (2017). Food swamps predict obesity rates better than food deserts in the United States. *International Journal of Environmental Research and Public Health*, *14*(11), 1366. https://doi.org/10.3390/ijerph14111366

Damms-Machado, A., Weser, G., & Bischoff, S. C. (2012). Micronutrient deficiency in obese subjects undergoing low calorie diet. *Nutrition Journal*, *11*(1), 34. https://doi.org/10.1186/1475-2891-11-34

Darmon, N., & Drewnowski, A. (2008). Does social class predict diet quality? *The American Journal of Clinical Nutrition, 87*(5), 1107 1117. https://doi.org/10.1093/ajcn/87.5.1107

Darmon, N., & Drewnowski, A. (2015). Contribution of food prices and diet cost to socioeconomic disparities in diet quality and health: A systematic review and analysis. *Nutrition Reviews, 73*(10), 643-660. https://doi.org/10.1093/nutrit/nuv027

Darmon, N., Ferguson, E. L., & Briend, A. (2002). A cost constraint alone has adverse effects on food selection and nutrient density: an analysis of human diets by linear programming. *The Journal of Nutrition*, *132*(12), 3764-3771. https://doi.org/10.1093/jn/132.12.3764

Data Axle. (2021). *We help you achieve your goals through data, technology, and services.* https://www.data-axle.com/

Diez Roux, A. V. (2001). Investigating neighborhood and area effects on health. *American Journal of Public Health, 91*(11), 1783-1789. https://doi.org/10.2105/AJPH.91.11.1783

Drewnowski, A. (2004). Obesity and the food environment: dietary energy density and diet costs. *American Journal of Preventive Medicine*, *27*(3), 154-162. https://doi.org/10.1016/j.amepre.2004.06.011

Dubowitz, T., Zenk, S. N., Ghosh-Dastidar, B., Cohen, D. A., Beckman, R., Hunter, G., Steiner, E. D., & Collins, R. L. (2015). Healthy food access for urban food desert residents: Examination of the food environment, food purchasing practices, diet and BMI. *Public Health Nutrition*, *18*(12), 2220-2230. https://doi.org/10.1017/S1368980014002742

Elbel, B., Tamura, K., McDermott, Z. T., Wu, E., & Schwartz, A. E. (2020). Childhood Obesity and the Food Environment: A Population-Based Sample of Public School Children in New York City. *Obesity, 28*(1), 65-72. https://doi.org/10.1002/oby.22663

Elliston, K. G., Ferguson, S. G., Schüz, N., & Schüz, B. (2017). Situational cues and momentary food environment predict everyday eating behavior in adults with overweight and obesity. *Health Psychology*, *36*(4), 337. https://doi.org/10.1037/hea0000439

Ells, L. J., Demaio, A., & Farpour-Lambert, N. (2018). Diet, genes, and obesity. *BMJ*, *360*. https://doi.org/10.1136/bmj.k7

Evans, A., Banks, K., Jennings, R., Nehme, E., Nemec, C., Sharma, S., Hussaini, A., & Yaroch, A. (2015). Increasing access to healthful foods: a qualitative study with residents of low-income communities. *International Journal of Behavioral Nutrition and Physical Activity*, *12*(S1), S5. https://doi.org/10.1186/1479-5868-12-S1-S5

Faries, M. D. Why we don't "just do it": Understanding the intention-behavior gap in lifestyle medicine. *American Journal of Lifestyle Medicine*, *10*(5), 322-329. https://doi.org/10.1177/1559827616638017

Feeding America. (2018). *Map the meal gap 2018: A report on county and congressional district food insecurity and county food cost in the United States in 2016.* https://www.feedingamerica.org/sites/default/files/research/map-the-meal-gap/2016/2016-map-the-meal-gap-full.pdf

Flater, D. (2011). Understanding geodesic buffering. *ArcUser Esri, Winter*, 33-36. https://www.esri.com/news/arcuser/0111/files/geodesic.pdf

Fichtner, A. (2017). Lay health coaching associated with improvements in abdominal circumference and reported psychosocial benefits in low-income African American women: A pilot study. *SM Journal of Family Medicine*, *1*(2), 1011. ISSN: 2576-0262

Figlewicz, D. P. (2015). Modulation of food reward by endocrine and environmental factors: Update and perspective. *Psychosomatic Medicine*, *77*(6), 664. https://doi.org/10.1097/PSY.0000000000000146

Finkelstein, E. A., Trogdon, J. G., Cohen, J. W., & Dietz, W. (2009). Annual medical spending attributable to obesity: Payer- and service-specific estimates. *Health Affairs*, *28*(5), w822-w831. https://doi.org/10.1377/hlthaff.28.5.w822

Fryar, C., Carroll, M., Ogder, C., Prevalence or overweight and obesity among children and adolescents aged 2–19 years: United States, 1963–1965 through 2013–2014. *Health E-Stats.* https://stacks.cdc.gov/view/cdc/58669

Gardner, B. (2015). A review and analysis of the use of ‘habit’ in understanding, predicting and influencing health-related behaviour. *Health Psychology Review*, *9*(3), 277-295. https://doi.org/10.1080/17437199.2013.876238

Ghosh-Dastidar, B., Cohen, D., Hunter, G., Zenk, S. N., Huang, C., Beckman, R., & Dubowitz, T. (2014). Distance to store, food prices, and obesity in urban food deserts. *American Journal of Preventive Medicine, 47*(5), 587-595. https://doi.org/10.1016/j.amepre.2014.07.005

Glanz, K., Handy, S. L., Henderson, K. E., Slater, S. J., Davis, E. L., & Powell, L. M. (2016). Built environment assessment: Multidisciplinary perspectives. *SSM-Population Health*, *2*, 24-31. https://doi.org/10.1016/j.ssmph.2016.02.002

Gollwitzer, P. M., & Sheeran, P. (2006). Implementation intentions and goal achievement: A meta-analysis of effects and processes. *Advances in Experimental Social Psychology*, *38*, 69-119. https://doi.org/10.1016/S0065-2601(06)38002-1

Gorski Findling, M. T., Wolfson, J. A., Rimm, E. B., & Bleich, S. N. (2018). Differences in the neighborhood retail food environment and obesity among US children and adolescents by SNAP participation. *Obesity, 26(*6), 1063-1071. https://doi.org/10.1002/oby.22184

Greenway, F. L. (2015). Physiological adaptations to weight loss and factors favouring weight regain. *International Journal of Obesity, 39*(8), 1188-1196. https://doi.org/10.1038/ijo.2015.59

Grummon, A. H., Sokol, R. L., Hecht, C. A., & Patel, A. I. (2018). *Assessing beverage intake in children and adolescents: State of the science, recommendations, and resources for evaluation.* University of California, Agriculture and Natural Resources. https://npi.ucanr.edu/files/287170.pdf

Guthrie, J. F., Lin, B. H., & Frazao, E. (2002). Role of food prepared away from home in the American diet, 1977-78 versus 1994-96: Changes and consequences. *Journal of Nutrition Education and Behavior*, *34*(3), 140-150. https://doi.org/10.1016/S1499-4046(06)60083-3

Hair, J., Black, W. C., Babin, B. J. & Anderson, R. E. (2010). *Multivariate data analysis* (7th ed.). Pearson Educational International.

Hales, C. M., Carroll, M. D., Fryar, C. D., & Ogden, C. L. (2020). *Prevalence of obesity and severe obesity among adults: United States, 2017–2018.* Centers for Disease Control and Prevention. https://www.cdc.gov/nchs/products/databriefs/db360.htm

Hall, K. D. (2018). Did the food environment cause the obesity epidemic? *Obesity, 26*(1), 11-13. https://doi.org/10.1002/oby.22073

Harris, J., Frazier, W., Kumanyika, S., & Ramirez, A. (2019). Increasing disparities in unhealthy food advertising targeted to Hispanic and Black youth. *Rudd Report.* http://uconnruddcenter. org/files/Pdfs/TargetedMarketingReport2019.pdf

Harrison, C. A., & Taren, D. (2018). How poverty affects diet to shape the microbiota and chronic disease. *Nature Reviews Immunology, 18*(4), 279. https://doi.org/10.1038/nri.2017.121

Hwalla, N., & Jaafar, Z. (2021). Dietary management of obesity: A review of the evidence. *Diagnostics*, *11*(1), 24. https://doi.org/10.3390/diagnostics11010024

Inagami, S., Cohen, D. A., Finch, B. K., & Asch, S. M. (2006). You are where you shop: Grocery store locations, weight, and neighborhoods. *American Journal of Preventive Medicine*, *31*(1), 10-17. https://doi.org/10.1016/j.amepre.2006.03.019

James, S. A., Fowler-Brown, A., Raghunathan, T. E., & Van Hoewyk, J. (2006). Life-course socioeconomic position and obesity in African American women: The Pitt County study. *American Journal of Public Health*, *96*(3), 554-560. https://doi.org/10.2105/AJPH.2004.053447

Jeffery, R. W., Baxter, J., McGuire, M., & Linde, J. (2006). Are fast food restaurants an environmental risk factor for obesity? *International Journal of Behavioral Nutrition and Physical Activity*, *3*(1), 2. https://doi.org/10.1186/1479-5868-3-2

Jetter, K. M., & Cassady, D. L. (2006). The availability and cost of healthier food alternatives. *American Journal of Preventive Medicine, 30*(1), 38-44. https://doi.org/10.1016/j.amepre.2005.08.039

Joyner, M. A., Kim, S., & Gearhardt, A. N. (2017). Investigating an incentive-sensitization model of eating behavior: impact of a simulated fast-food laboratory. *Clinical Psychological Science*, *5*(6), 1014-1026. https://doi.org/10.1177/2167702617718828

Kaidar-Person, O., Person, B., Szomstein, S., & Rosenthal, R. J. (2008). Nutritional deficiencies in morbidly obese patients: A new form of malnutrition? *Obesity Surgery*, *18*(7), 870-876. https://doi.org/10.1007/s11695-007-9350-5

Keller, C., Markert, F., & Bucher, T. (2015). Nudging product choices: The effect of position change on snack bar choice. *Food Quality and Preference, 41,* 41-43. https://doi.org/10.1016/j.foodqual.2014.11.005

Kim, D. D., & Basu, A. (2016). Estimating the medical care costs of obesity in the United States: Systematic review, meta-analysis, and empirical analysis. *Value in Health*, *19*(5), 602-613. https://doi.org/10.1016/j.jval.2016.02.008

Kimmons, J., Gillespie, C., Seymour, J., Serdula, M., & Blanck, H. M. (2009). Fruit and vegetable intake among adolescents and adults in the United States: Percentage meeting individualized recommendations. *The Medscape Journal of Medicine*, *11*(1), 26. PMCID: PMC2654704

Konttinen, H. (2020). Emotional eating and obesity in adults: The role of depression, sleep and genes. *Proceedings of the Nutrition Society, 79*(3), 283-289. https://doi.org/10.1017/S0029665120000166

Kothe, E. J., Sainsbury, K., Smith, L., & Mullan, B. A. (2015). Explaining the intention–behaviour gap in gluten-free diet adherence: The moderating roles of habit and perceived behavioural control. *Journal of Health Psychology*, *20*(5), 580-591. https://doi.org/10.1177/1359105315576606

Kraft, A. N., Thatcher, E. J., & Zenk, S. N. (2020). Neighborhood food environment and health outcomes in US Low-Socioeconomic status, racial/ethnic minority, and rural populations: a Systematic review. *Journal of Health Care for the Poor and Underserved, 31*(3), 1078-1114. https://doi.org/10.1353/hpu.2020.0083

Kroese, F. M., Marchiori, D. R., & de Ridder, D. T. (2016). Nudging healthy food choices: A field experiment at the train station. *Journal of Public Health, 38*(2), e133-e137. https://doi.org/10.1093/pubmed/fdv096

Kwate, N. O. A. (2008). Fried chicken and fresh apples: racial segregation as a fundamental cause of fast food density in black neighborhoods. *Health & Place*, *14*(1), 32-44. https://doi.org/10.1016/j.healthplace.2007.04.001

Kwate, N. O. A., Yau, C. Y., Loh, J. M., & Williams, D. (2009). Inequality in obesigenic environments: Fast food density in New York City. *Health & Place*, *15*(1), 364-373. https://doi.org/10.1016/j.healthplace.2008.07.003

Laraia, B. A., Siega-Riz, A. M., Kaufman, J. S., & Jones, S. J. (2004). Proximity of supermarkets is positively associated with diet quality index for pregnancy. *Preventive Medicine*, *39*(5), 869-875. https://doi.org/10.1016/j.ypmed.2004.03.018

Larsen, J. K., Hermans, R. C., Sleddens, E. F., Vink, J. M., Kremers, S. P., Ruiter, E. L., & Fisher, J. O. (2018). How to bridge the intention-behavior gap in food parenting: Automatic constructs and underlying techniques. *Appetite*, *123*, 191-200. https://doi.org/10.1016/j.appet.2017.12.016

Ledoux, T. F., Vojnovic, I., Manning Thomas, J., & Pothukuchi, K. (2017). Standing in the shadows of obesity: The local food environment and obesity in Detroit. *Tijdschrift Voor Economische en Sociale Geografie*, *108*(5), 605-624. https://doi.org/10.1111/tesg.12227

Leigh, S. J., & Morris, M. J. (2018). The role of reward circuitry and food addiction in the obesity epidemic: An update. *Biological Psychology*, *131*, 31-42. https://doi.org/10.1016/j.biopsycho.2016.12.013

Leng, G., Adan, R.A., Belot, M., Brunstrom, J.M., de Graaf, K., Dickson, S.L., Hare, T., Maier, S., Menzies, J., Preissl, H. and Reisch, L.A. (2017). The determinants of food choice. *Proceedings of the Nutrition Society, 76*(3), 316-327. https://doi.org/10.1017/S002966511600286X

Leung, A. W., Chan, R. S., Sea, M. M., & Woo, J. (2017). An overview of factors associated with adherence to lifestyle modification programs for weight management in adults. *International Journal of Environmental Research and Public Health*, *14*(8), 922. https://doi.org/10.3390/ijerph14080922

Li, Y., Robinson, L. E., Carter, W. M., & Gupta, R. (2015). Childhood obesity and community food environments in Alabama's Black Belt region. *Child: Care, Health and Development, 41*(5), 668-676. https://doi.org/10.1111/cch.12204

Li, X., Shimizu, Y., & Kimura, I. (2017). Gut microbial metabolite short-chain fatty acids and obesity. *Bioscience of Microbiota, Food and Health*, 17-010. https://doi.org/10.12938/bmfh.17-010

Liburd, L. C. (2003). Food, identity, and African-American women with type 2 diabetes: An anthropological perspective. *Diabetes Spectrum*, *16*(3), 160-165. https://doi.org/10.2337/diaspect.16.3.160

Liese, A. D., Bell, B. A., Barnes, T. L., Colabianchi, N., Hibbert, J. D., Blake, C. E., & Freedman, D. A. (2014). Environmental influences on fruit and vegetable intake: Results from a path analytic model. *Public Health Nutrition, 17*(11), 2595-2604. https://doi.org/10.1017/S1368980013002930

Livingstone, K. M., Burton, M., Brown, A. K., & McNaughton, S. A. (2020). Exploring barriers to meeting recommendations for fruit and vegetable intake among adults in regional areas: A mixed-methods analysis of variations across socio-demographics. *Appetite*, 104750. https://doi.org/10.1016/j.appet.2020.104750

Lo, C. P. & Yeung, A. K. W. (2002). *Concepts and techniques of geographic information systems.* Prentice Hall, Inc.

Maas, J., de Ridder, D. T., de Vet, E., & De Wit, J. B. (2012). Do distant foods decrease intake? The effect of food accessibility on consumption. *Psychology & Health, 27*(sup2), 59-73. https://doi.org/10.1080/08870446.2011.565341

MacCann, C., Todd, J., Mullan, B. A., & Roberts, R. D. (2015). Can personality bridge the intention-behavior gap to predict who will exercise? *American Journal of Health Behavior*, *39*(1), 140-147. https://doi.org/10.5993/AJHB.39.1.15

Mackenbach, J. D., Nelissen, K. G., Dijkstra, S. C., Poelman, M. P., Daams, J. G., Leijssen, J. B., & Nicolaou, M. (2019). A systematic review on socioeconomic differences in the association between the food environment and dietary behaviors. *Nutrients, 11*(9), 2215. https://doi.org/10.3390/nu11092215

Maddock, J. (2004). The relationship between obesity and the prevalence of fast food restaurants: State-level analysis. *American Journal of Health Promotion*, *19*(2), 137-143. https://doi.org/10.4278/0890-1171-19.2.137

Marcone, M. F., Madan, P., & Grodzinski, B. (2020). An overview of the sociological and environmental factors influencing eating food behavior in Canada. *Frontiers in Nutrition, 7,* 77. https://doi.org/10.3389/fnut.2020.00077

Mason, A.E., Schmidt, L., Ishkanian, L., Jacobs, L.M., Leung, C., Jensen, L., Cohn, M.A., Schleicher, S., Hartman, A.R., Wojcicki, J.M., Lustig, R.H., & Epel, E.S. (2021). A brief motivational intervention differentially reduces sugar-sweetened beverage (SSB) consumption. *Annals of Behavioral Medicine*, *55*(11), 1116-1129. https://doi.org/10.1093/abm/kaaa123

McDermott, M.S., Oliver, M., Simnadis, T., Beck, E.J., Coltman, T., Iverson, D., Caputi, P., & Sharma, R., (2015). The theory of planned behaviour and dietary patterns: A systematic review and meta-analysis. *Preventive Medicine, 81,* 150-156. https://doi.org/10.1186/s12966-015-0324-z

Meng, X., Huang, D., Ao, H., Wang, X., & Gao, X. (2020). Food cue recruits increased reward processing and decreased inhibitory control processing in the obese/overweight: An activation likelihood estimation meta-analysis of fMRI studies. *Obesity Research & Clinical Practice*, *14*(2), 127-135. https://doi.org/10.1016/j.orcp.2020.02.004

Miller, W. R., & Rollnick, S. (2002). *Motivational interviewing: Preparing people for change.* Guilford Press.

Minaker, L., Fisher, P., Raine, K., & Frank, L. (2011). Measuring the food environment: From theory to planning practice. *Journal of Agriculture, Food Systems, and Community Development*, *2*(1), 65-82. https://doi.org/10.5304/jafscd.2011.021.021

Mirkarimi, K., Mostafavi, F., Eshghinia, S., Vakili, M. A., Ozouni-Davaji, R. B., & Aryaie, M. (2015). Effect of motivational interviewing on a weight loss program based on the protection motivation theory. *Iranian Red Crescent Medical Journal*, *17*(6), e23492. https://doi.org/10.5812/ircmj.23492v2

Monds, L. A., MacCann, C., Mullan, B. A., Wong, C., Todd, J., & Roberts, R. D. (2016). Can personality close the intention-behavior gap for healthy eating? An examination with the HEXACO personality traits. *Psychology, Health & Medicine*, *21*(7), 845-855. https://doi.org/10.1080/13548506.2015.1112416

Morales, I., & Berridge, K. C. (2020). 'Liking' and 'wanting' in eating and food reward: Brain mechanisms and clinical implications. *Physiology & Behavior,* 113152. https://doi.org/10.1016/j.physbeh.2020.113152

Morland, K., Roux, A. V. D., & Wing, S. (2006). Supermarkets, other food stores, and obesity: The atherosclerosis risk in communities study. *American Journal of Preventive Medicine*, *30*(4), 333-339. https://doi.org/10.1016/j.amepre.2005.11.003

Morland, K., Wing, S., & Roux, A. D. (2002). The contextual effect of the local food environment on residents' diets: The atherosclerosis risk in communities study. *American Journal of Public Health*, *92*(11), 1761-1768. https://doi.org/10.2105/AJPH.92.11.1761

Morys, F., García-García, I., & Dagher, A. (2020). Is obesity related to enhanced neural reactivity to visual food cues? A review and meta-analysis. *Social Cognitive and Affective Neuroscience*. https://doi.org/10.1093/scan/nsaa113

Moyers, T. B., Martin, J. K., Houck, J. M., Christopher, P.J., & Tonigan, J. S. (2009). From in-session behaviors to drinking outcomes: A causal chain for motivational interviewing. *Journal of Consulting and Clinical Psychology*, 77(6), 1113-1124. https://doi.org/10.1037/a0017189

Munt, A. E., Partridge, S. R., & Allman-Farinelli, M. (2017). The barriers and enablers of healthy eating among young adults: A missing piece of the obesity puzzle: A scoping review. *Obesity Reviews*, *18*(1), 1-17. https://doi.org/10.1111/obr.12472

Neckerman, K. M., Bader, M., Purciel, M., & Yousefzadeh, P. (2009, February 9). *Measuring food access in urban areas*. Columbia University Built Environment and Health. https://www.academia.edu/19876265/Measuring_food_access_in_urban_areas

Nguyen, B. T., Shuval, K., Bertmann, F., & Yaroch, A. L. (2015). The Supplemental Nutrition Assistance Program, food insecurity, dietary quality, and obesity among US adults. *American Journal of Public Health*, *105*(7), 1453-1459. https://doi.org/10.2105/AJPH.2015.302580

Odoms-Young, A., Singleton, C. R., Springfield, S., McNabb, L., & Thompson, T. (2016). Retail environments as a venue for obesity prevention. *Current Obesity Reports, 5*(2), 184-191. https://doi.org/10.1007/s13679-016-0219-6

Ohri-Vachaspati, P., Isgor, Z., Rimkus, L., Powell, L. M., Barker, D. C., & Chaloupka, F. J. (2015). Child-directed marketing inside and on the exterior of fast food restaurants. *American Journal of Preventive Medicine*, *48*(1), 22-30. https://doi.org/10.1016/j.amepre.2014.08.011

Orji, R., & Mandryk, R. L. (2014). Developing culturally relevant design guidelines for encouraging healthy eating behavior. *International Journal of Human-Computer Studies*, *72*(2), 207-223. https://doi.org/10.1016/j.ijhcs.2013.08.012

Paquet, C., de Montigny, L., Labban, A., Buckeridge, D., Ma, Y., Arora, N., & Dubé, L. (2017). The moderating role of food cue sensitivity in the behavioral response of children to their neighborhood food environment: a cross-sectional study. *International Journal of Behavioral Nutrition and Physical Activity, 14*(1), 1-12. https://doi.org/10.1186/s12966-017-0540-9

Parise, I. (2020). The built environment and obesity: You are where you live. *Australian Journal of General Practice, 49*, 226-230. https://doi.org/10.31128/AJGP-10-19-5102

Park, M. H., Falconer, C. L., Croker, H., Saxena, S., Kessel, A. S., Viner, R. M., & Kinra, S. (2014). Predictors of health-related behaviour change in parents of overweight children in England. *Preventive Medicine*, *62*, 20-24. https://doi.org/10.1016/j.ypmed.2014.02.002

Pavela, G., Lewis, D. W., Locher, J., & Allison, D. B. (2016). Socioeconomic status, risk of obesity, and the importance of Albert J. Stunkard. *Current Obesity Reports*, *5*(1), 132-139. https://doi.org/10.1007/s13679-015-0185-4

Pechey, R., & Marteau, T. M. (2018). Availability of healthier vs. less healthy food and food choice: An online experiment. *BMC Public Health, 18*(1), 1-11. https://doi.org/10.1186/s12889-018-6112-3

Polivy, J., & Herman, C. P. (2017). Restrained eating and food cues: Recent findings and conclusions. *Current Obesity Reports*, *6*(1), 79-85. https://doi.org/10.1007/s13679-017-0243-1

Prochaska, J. O., & Velicer, W. F. (1997). The transtheoretical model of health behavior change. *American Journal of Health Promotion, 12*(1), 38-48. https://doi.org/10.4278/0890-1171-12.1.38

Qi, Q., Chu, A. Y., Kang, J. H., Huang, J., Rose, L. M., Jensen, M. K., Liang, L., Curhan, G. C., Pasquale, L. R., Wiggs, J. L., & De Vivo, I. (2014). Fried food consumption, genetic risk, and body mass index: gene-diet interaction analysis in three US cohort studies. *BMJ, 348*, g1610. https://doi.org/10.1136/bmj.g1610

Raghoebar, S., van Rongen, S., Lie, R., & de Vet, E. (2019). Identifying social norms in physical aspects of food environments: A photo study. *Appetite, 143,* 104414. https://doi.org/10.1016/j.appet.2019.104414

Raskind, I. G., Kegler, M. C., Girard, A. W., Dunlop, A. L., & Kramer, M. R. (2020). Abstract P533: Food shopping practices of low-income African American women: Associations with features of the food environment. *Circulation*, *141*(Suppl_1), AP533. https://doi.org/10.1161/circ.141.suppl_1.P533

Ravelli, M. N., & Schoeller, D. A. (2020). Traditional self-reported dietary instruments are prone to inaccuracies and new approaches are needed. *Frontiers in Nutrition*, *7*, 90. https://doi.org/10.3389/fnut.2020.00090

Raynor, H. A., & Champagne, C. M. (2016). Position of the Academy of Nutrition and Dietetics: Interventions for the treatment of overweight and obesity in adults. *Journal of the Academy of Nutrition and Dietetics*, *116*(1), 129-147. https://doi.org/10.1016/j.jand.2015.10.031

Reel, J. J., & Badger, B. K. (2014). From food deserts to food swamps: Health education strategies to improve food environments in urban areas. *Journal of Obesity & Weight Loss Therapy, 4*(2), S4-002. https://doi.org/10.4172/2165-7904.S4-002

Reuter, T., Ziegelmann, J. P., Wiedemann, A. U., & Lippke, S. (2008). Dietary planning as a mediator of the intention–behavior relation: An experimental-causal-chain design. *Applied Psychology*, *57*, 194-207. https://doi.org/10.1111/j.1464-0597.2008.00364.x

Rhodes, R. E., & de Bruijn, G. J. (2013). How big is the physical activity intention–behaviour gap? A meta-analysis using the action control framework. *British Journal of Health Psychology*, *18*(2), 296-309. https://doi.org/10.1111/bjhp.12032

Rhodes, R. E., & Dickau, L. (2012). Experimental evidence for the intention–behavior relationship in the physical activity domain: A meta-analysis. *Health Psychology*, *31*(6), 724. https://doi.org/10.1037/a0027290

Rhodes, R. E., & Dickau, L. (2013). Moderators of the intention-behaviour relationship in the physical activity domain: A systematic review. *British Journal of Sports Medicine*, *47*(4), 215-225. https://doi.org/10.1136/bjsports-2011-090411

Rhodes, R. E., Brown, S. G., & McIntyre, C. A. (2006). Integrating the perceived neighborhood environment and the theory of planned behavior when predicting walking in a Canadian adult sample. *American Journal of Health Promotion*, *21*(2), 110-118. https://doi.org/10.4278/0890-1171-21.2.110

Richardson, A. S., Meyer, K. A., Howard, A. G., Boone-Heinonen, J., Popkin, B. M., Evenson, K. R., Shikany, J.M., Lewis, C.E., & Gordon-Larsen, P. (2015). Multiple pathways from the neighborhood food environment to increased body mass index through dietary behaviors: A structural equation-based analysis in the CARDIA study. *Health & Place*, *36*, 74-87. https://doi.org/10.1016/j.healthplace.2015.09.003

Rollnick, S., Heather, N., Gold, R., & Hall, W. (1992). Development of a short 'readiness to change' questionnaire for use in brief, opportunistic interventions among excessive drinkers. *British Journal of Addiction*, *87*(5), 743-754. https://doi.org/10.1111/j.1360-0443.1992.tb02720.x

Rose, D., & Richards, R. (2004). Food store access and household fruit and vegetable use among participants in the US Food Stamp Program. *Public Health Nutrition*, *7*(8), 1081-1088. https://doi.org/10.1079/PHN2004648

Saelens, B. E., Arteaga, S. S., Berrigan, D., Ballard, R. M., Gorin, A. A., Powell-Wiley, T. M., T.M., Pratt, C., Reedy, J., & Zenk, S. N. (2018). Accumulating data to optimally predict obesity treatment (ADOPT) core measures: Environmental domain. *Obesity*, *26*, S35-S44. https://doi.org/10.1002/oby.22159

Santarossa, S., Hill, A.B., Sitarik, A.R., Taylor, M., Hawkins, S., Scher, K., Sohaski, A., Baseer, M., Dombrowski, R., Plum, A., & Joseph, C.L. (2022). Food insecurity in Detroit: Exploring the relationship between patient-reported food insecurity and proximity to healthful grocery stores. *Public Health Nutrition, 25*(4), 954-963. https://doi.org/10.1017/S1368980021003128

Schulz, A. J., Williams, D. R., Israel, B. A., & Lempert, L. B. (2002). Racial and spatial relations as fundamental determinants of health in Detroit. *The Milbank Quarterly*, *80*(4), 677-707. https://doi.org/10.1111/1468-0009.00028

Sheeran, P., & Abraham, C. (2003). Mediator of moderators: Temporal stability of intention and the intention-behavior relation. *Personality and Social Psychology Bulletin*, *29*(2), 205-215. https://doi.org/10.1177/0146167202239046

Sheeran, P., & Webb, T. L. (2016). The intention–behavior gap. *Social and Personality Psychology Compass*, *10*(9), 503-518. https://doi.org/10.1111/spc3.12265

SICCODE.com. (2020). *SIC code & NAICS code business lists.* https://siccode.com/

Simonnet, A., Chetboun, M., Poissy, J., Raverdy, V., Noulette, J., Duhamel, A. Labreuche, J., Mathieu, D., Pattou, F., & Jourdain, M. (2020). High prevalence of obesity in severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2) requiring invasive mechanical ventilation. *Obesity, 28*(7), 1195-1199. https://doi.org/10.1002/oby.22831

Skinner, A. T., Bacchini, D., Lansford, J. E., Godwin, J. W., Sorbring, E., Tapanya, S., Tirado, L. M. U., Zelli, A., Alampay, L. P., Al-Hassan, S. M., Bombi, A. S., Bornstein, M. H., Chang, L., Deater-Deckard, K., Giunta, L. D., Dodge, K. A., Malone, P. S., Miranda, M. C., Oburu, P., & Pastorelli, C. (2014). Neighborhood danger, parental monitoring, harsh parenting, and child aggression in nine countries. *Societies*, *4*(1), 45-67. https://doi.org/10.3390/soc4010045

Sniehotta, F. F., Scholz, U., & Schwarzer, R. (2005). Bridging the intention–behaviour gap: Planning, self-efficacy, and action control in the adoption and maintenance of physical exercise. *Psychology & Health*, *20*(2), 143-160. https://doi.org/10.1080/08870440512331317670

Stilley, M. (2012). *Urban food deserts: An exploration of northern neighborhoods in Denver*. University of Colorado at Denver.

Story, M., Kaphingst, K. M., Robinson-O'Brien, R., & Glanz, K. (2008). Creating healthy food and eating environments: Policy and environmental approaches. *Annual Review of Public Health*, *29*, 253-272. https://doi.org/10.1146/annurev.publhealth.29.020907.090926

Sumithran, P., & Proietto, J. (2013). The defence of body weight: A physiological basis for weight regain after weight loss. *Clinical Science, 124*(4), 231-241. https://doi.org/10.1042/CS20120223

Swinburn, B. A., Caterson, I., Seidell, J. C., & James, W. P. T. (2004). Diet, nutrition and the prevention of excess weight gain and obesity. *Public Health Nutrition*, *7*(1a), 123-146. https://doi.org/10.1079/PHN2003585

Tanumihardjo, S. A., Anderson, C., Kaufer-Horwitz, M., Bode, L., Emenaker, N. J., Haqq, A. M., Satia, J. A., Silver, H. J., & Stadler, D. D. (2007). Poverty, obesity, and malnutrition: An international perspective recognizing the paradox. *Journal of the American Dietetic Association*, *107*(11), 1966-1972. https://doi.org/10.1016/j.jada.2007.08.007

Taylor, D., & Ard, K. (2015). Food availability and the food desert frame in Detroit: An overview of the city's food system. *Environmental Practice, 17*(2), 102-133. https://doi.org/10.1017/S1466046614000544

Teixeira, P. J., Carraça, E. V., Marques, M. M., Rutter, H., Oppert, J. M., De Bourdeaudhuij, I., Lakerveld, J., & Brug, J. (2015). Successful behavior change in obesity interventions in adults: A systematic review of self-regulation mediators. *BMC Medicine, 13*(1), 1-16. https://doi.org/10.1186/s12916-015-0323-6

Upadhyay, J., Farr, O., Perakakis, N., & Ghaly, W., Mantzoros, C. (2017). Obesity as a disease. *Obesity Medicine, An Issue of Medical Clinics of North America, E-Book*, *102*(1), 13-33.

U.S. Department of Health and Human Services and U.S. Department of Agriculture. (2015). *2015–2020 dietary guidelines for Americans.* http://health.gov/dietaryguidelines/2015/guidelines/

van Leer, E., Hapner, E. R., & Connor, N. P. (2008). Transtheoretical model of health behavior change applied to voice therapy. *Journal of Voice, 22*(6), 688-698. https://doi.org/10.1016/j.jvoice.2007.01.011

Wakimoto, P., & Block, G. (2001). Dietary intake, dietary patterns, and changes with age: An epidemiological perspective. *The Journals of Gerontology Series A: Biological Sciences and Medical Sciences*, *56*(suppl_2), 65-80. https://doi.org/10.1093/gerona/56.suppl_2.65

Wang, T., Heianza, Y., Sun, D., Huang, T., Ma, W., Rimm, E.B., Manson, J.E., Hu, F.B., Willett, W.C. and Qi, L. (2018). Improving adherence to healthy dietary patterns, genetic risk, and long term weight gain: Gene-diet interaction analysis in two prospective cohort studies. *BMJ*, *360*. https://doi.org/10.1136/bmj.j5644

Watson, P., Wiers, R. W., Hommel, B., Gerdes, V. E., & de Wit, S. (2017). Stimulus control over action for food in obese versus healthy-weight individuals. *Frontiers in Psychology*, *8*, 580. https://doi.org/10.3389/fpsyg.2017.00580

Werthmann, J., Jansen, A., & Roefs, A. (2016). Make up your mind about food: A healthy mindset attenuates attention for high-calorie food in restrained eaters. *Appetite*, *105*, 53-59. https://doi.org/10.1016/j.appet.2016.05.005

Wheaton, L., & Tran, V. (2018). *The antipoverty effects of the supplemental nutrition assistance program.* Urban Institute.

Wieber, F., Thürmer, J. L., & Gollwitzer, P. M. (2015). Promoting the translation of intentions into action by implementation intentions: Behavioral effects and physiological correlates. *Frontiers in Human Neuroscience*, *9*, 395. https://doi.org/10.3389/fnhum.2015.00395

Wong, M. S., Chan, K. S., Jones-Smith, J. C., Colantuoni, E., Thorpe Jr, R. J., & Bleich, S. N. (2018). The neighborhood environment and obesity: Understanding variation by race/ethnicity. *Preventive Medicine, 111*, 371-377. https://doi.org/10.1016/j.ypmed.2017.11.029

Xin, J., Zhao, L., Wu, T., Zhang, L., Li, Y., Xue, H., Xiao, Q., Wang, R., Xu, P., Visscher, T., Ma, X., Jia, P. (2019). Association between access to convenience stores and childhood obesity: A systematic review. *Obesity Reviews, 22,* e12908. https://doi.org/10.1111/obr.12908

Zenk, S. N., Lachance, L. L., Schulz, A. J., Mentz, G., Kannan, S., & Ridella, W. (2009). Neighborhood retail food environment and fruit and vegetable intake in a multiethnic urban population. *American Journal of Health Promotion*, *23*(4), 255-264. https://doi.org/10.4278/ajhp.071204127

Zenk, S. N., Schulz, A. J., & Odoms-Young, A. (2009). How neighborhood environments contribute to obesity. *The American Journal of Nursing*, *109*(7), 61. https://doi.org/10.1097/01.NAJ.0000357175.86507.c8

Zhen, C. (2021). Food deserts: Myth or reality? *Annual Review of Resource Economics, 13,* 109-129. https://doi.org/10.1146/annurev-resource-101620-080307

Zhi, C., Huang, J., Wang, J., Cao, H., Bai, Y., Guo, J., & Su, Z. (2019). Connection between gut microbiome and the development of obesity. *European Journal of Clinical Microbiology & Infectious Diseases, 38*(11), 1987-1998. https://doi.org/10.1007/s10096-019-03623-x

Zhou, Q., Zhao, L., Zhang, L., Xiao, Q., Wu, T., Visscher, T., Zhao, J., Xin, J., Yu, X., Xue, H., Li, H., Pan, J., & Jia, P. (2021). Neighborhood supermarket access and childhood obesity: A systematic review. *Obesity Reviews*, *22*, e12937. https://doi.org/10.1111/obr.12937

Ziauddeen, H., Alonso-Alonso, M., Hill, J. O., Kelley, M., & Khan, N. A. (2015). Obesity and the neurocognitive basis of food reward and the control of intake. *Advances in Nutrition*, *6*(4), 474-486. https://doi.org/10.3945/an.115.008268

APPENDICES

Appendix A: Home Safety Information Form

1. Type of Home:
    ____Single family house
    ____Multi-family house
    ____Apartment
    ____Condominium/townhouse
    ____Other ________________

2. Cleanliness: Were there pests or other hazards in the home?

    ____

3. Number of Exits/Entrances: assess the potential that non-family members may have access to the home and whether research staff can easily exit the house if needed

    ____

4. Doors locked and by what means (bars, gates). Could study personnel exit the home easily if need be?

    ____

5. Who was in the home: description of the family structure, are there friends who just pop over?

    ____

6. Presence of Alcohol/ Drugs: any indicators of substance abuse and any associated safety concerns?

    ____

7. Suggestive Behaviors: were there examples of overt intimidation or other safety concerns by any members of the family/ persons present in the home?

    ____

8. Bizarre Behavior: were there indicators of serious mental health problems, domestic violence or other potentially dangerous situations?

    ____

9. Approached by someone outside the home: did people on the street talk to or stare, was the neighborhood dangerous or unsafe based on multiple abandoned buildings, evidence of drugs etc.?

---

10. Street Parking Available: would there be a safe, well-lit place for study staff to park or would research team personnel be forced to walk down an unfamiliar street after dark or park on the street?

---

11. Other Safety Concerns: were there any other situations/concerns provoking feelings of discomfort or a lack of safety

Appendix B: Informed Consent Form

RESEARCH @ EMU

Informed Consent Form

Study Title: Parent Focused Nutrition and Activity Intervention for Head Start Preschoolers

Principal Investigator (PI): Dr. Heather Janisse, Ph.D.
Psychology Department, Eastern Michigan University
(734) 487-0096; hjanisse@emich.edu

Funding Source: **The National Institute of Diabetes and Digestive and Kidney Diseases**

Purpose of the study

You and your child are being asked to take part in a research study that examines the effectiveness of a nutrition and activity intervention program designed to improve the health behaviors and outcomes of Head Start parents and children. Your child has been selected because their current weight is above the recommended weight for their age. This study is being conducted at Eastern Michigan University. The maximum number of study participants to be enrolled in the study is 100. **Please read this form and ask any questions you may have before agreeing to be in the study.**

The purpose of this study is to determine which program is better at helping Head Start parents improve their child's nutrition and physical activity behaviors: a home-based program that addresses the motivation of parents or a support program that offers newsletters and telephone calls.

Study Procedures

If you take part in the study, study personnel will meet you at your home or Head Start Center and you will complete questionnaires. These questionnaires will ask about you and your child's current nutrition and activity behaviors, your parenting behaviors, your motivation for health behavior change, and your child's behavior. These questionnaires will take you approximately 2 ½ hours to complete. We will also take a measure of you and your child's height, weight and blood pressure and we will ask you to have your child wear an activity measuring device on their clothes for four days (called an accelerometer). This device hooks on the clothes or belt loop. We will also take a brief video of you and your child interacting during a snack time.

Next, you and your child will be randomly assigned to receive either a home-based program or a newsletter with support program. Random assignment means that you/your child will be assigned by chance (like the flip of a coin) to receive the home-based program or the newsletter with support program.

If you are assigned to the home based program, sessions targeting improving your knowledge and your motivation for changing nutrition and activity behaviors will be provided in your home at a time convenient for your family. A community health worker will come to your home and program sessions will last about 1-1 ½ hours. There will be a total of 8 sessions provided over approximately a 4-month time period (resulting in 1 session about every other week). These home sessions will focus on a variety of topics including, understanding current nutrition and activity recommendations for your preschool age child, parenting approaches to increase healthy behaviors of your child, skills building, problem

Approved by the Eastern Michigan University Human Subjects Review Committee
UHSRC Protocol Number: 738343-1
Study Approval Dates: 4/16/15 – 4/15/16

solving and increasing motivation for health behavior change. The importance of connecting with your child's primary care doctor will be discussed.

If you are assigned to the newsletter with support program, there will be just one home visit at the beginning of the program scheduled at a time convenient for your family. This visit will emphasize the importance of healthy nutrition and activity for your child and family and the importance of connecting with your primary care doctor will be discussed. Following this session, you will receive 7 newsletters over a 4-month time period that will include information on nutrition, physical activity, parenting behavior and community resources. You will also receive one monthly phone call for 4-months designed to review newsletter content and answer questions you may have (4 phone calls in total). Some of the sessions or phone calls will be audiotaped. The purpose of taping the sessions is to be certain that the community health workers provide the best quality program to your family. Audiotapes will be destroyed upon completion of the study.

Right after the program you participated in is complete and again six and twelve months later, study research personnel will call you to schedule a time for you and your child to complete the same measures you competed at the start of the study over again. This includes questionnaires about you and your child's nutrition and activity behaviors, your parenting behaviors, your motivation for health behavior change and your child's behavior. We will take another measure of you and your child's height, weight and blood pressure and we will ask you to have your child wear the accelerometer on their clothes for four days. We will also take a video of you and your child interacting during a snack time. Half way through the program, you will receive one phone call to see if you or child has experienced any problems or concerns since being in the program. The total length of participation in the study is 16 months.

Benefits

The possible benefits to you and your child for taking part in this study are that you may improve your health behavior knowledge and you and your child's dietary intake and physical activity. This may result in a healthier weight status for your child. However, there are no guarantees that this will occur. Additionally, the information from this study may benefit other children/families now or in the future.

Risks

By taking part in this study, you or your child may experience the following risks:

- Although behavioral programs such as the ones described in this form are generally expected to reduce distress and therefore be of minimal risk, behavior change can be difficult. Therefore, risks include the possibility of temporary increased distress during the program intervention.

- You or your child may become tired from completing questionnaires or study measures. You could also become upset from answering personal questions. You or your child may decline to answer any questions during your participation.

- Although no discomfort from wearing the physical activity monitor is expected, your child may express a dislike for wearing the monitor or may experience some discomfort or irritation. Wearing the device on the outside of the clothes and taking it off during sleep should reduce this risk.

- We are required by law to report to the appropriate authorities if at any time during the study there is concern that child abuse has possibly occurred.

Approved by the Eastern Michigan University Human Subjects Review Committee
UHSRC Protocol Number: 738343-1
Study Approval Dates: 4/16/15 – 4/15/16

There may also be risks involved from taking part in this study that are not known to researchers at this time. In the unlikely event that distressing personal concerns arise during or after your participation in this study, please let us know and we will provide you with information on who you can contact for assistance. You may contact the Principal Investigator for this study at 734.487.0096 or you may contact the following Detroit/Wayne County service provider: *24-Hour Crisis, Information & Referral Line for Detroit, MI (313) 224-7000 or (800) 241-4949.*

Alternatives
If you choose not to be in this study there are other options available that you can talk about with your doctor, who can assist you or provide you with more resources. Some other options include attending nutrition education classes or getting counseling for your child in your community. Head Start staff may also be able to provide you with community resources.

Confidentiality
All information collected about you and your child from this study will remain confidential. You and your child will be identified in the research records by a code number. Information that identifies you and your child personally will not be released without your written permission. Only the staff involved in this project will have access to the information we collect and all information will be kept in a locked office and on password protected computers and files. However, the study sponsor and the Institutional Review Board (IRB) at Eastern Michigan University may review your records.

Information we obtain may be reported in scholarly publications and presentations. When the results of this research are published or discussed in conferences, no information will be included that would reveal you or your child's identity. We will primarily report summarized results. If any individual comments are reported, we will not disclose any information that can be identified with you. Audio and video recordings will be destroyed upon completion of the study.

Study Costs
Participation in this study will be of no cost to you.

Compensation
For taking part in this research study, you will be paid for your time and inconvenience. You will receive $30 immediately after each data collection visit you and your child complete and another $20 after your child has worn the activity monitor and it is returned, for a total of $50. Because there are 4 data collection visits, you have the potential to earn $200 if you complete all four. In addition, participants who are assigned to the home based program may receive additional incentives like cookbooks or food products.

Voluntary participation
Taking part in this study is voluntary. You may choose not to take part in this study, or if you decide to take part, you can change your mind later and withdraw from the study. You are free to refuse to answer any question(s) or withdraw at any time. Your decision about participation will have no effect on the services you receive from Head Start or any other service agency. Your decision will not change any present or future relationships with Eastern Michigan University or its affiliates or other services you are entitled to receive. If any new information comes up that would possibly change your willingness to participate in this study, we will let you know.

Approved by the Eastern Michigan University Human Subjects Review Committee
UHSRC Protocol Number: 738343-1
Study Approval Dates: 4/16/15 – 4/15/16

Study contact information
If you have any questions about the research, you can contact the Principal Investigator, Dr. Heather Janisse, at hjanisse@emich.edu or by phone at 734-487-0096. For questions about your rights as a research participant, contact the Eastern Michigan University Human Subjects Review Committee at human.subjects@emich.edu or by phone at 734-487-3090.

Statement of Consent
To voluntarily agree to have you and your child take part in this study, you must sign on the line below. If you choose to take part in this study, you may withdraw at any time. You are not giving up any legal rights by signing this form. Your signature below indicates that you have read, or had read to you, this entire consent form, including the risks and benefits, and have had all of your questions answered. You will be given a copy of this consent form.

Signatures

____
Name of Participant

___________________________________ ____________________
Signature of Participant Date

Permission to obtain data collected by the Head Start Program from your child
By signing below you are giving the researchers permission to access the results of the routine assessments given to your child at Head Start (The Brigance and the CORE). This additional information will allow us to look at whether our program influences these outcomes for your child.

____ _____________________
Signature of Participant Date

I have explained the research to the participant and answered all his/her questions. I will give a copy of the signed consent form to the participant.

_____________________________ ___________________________ ______________
Name of Person Obtaining Consent Signature Date

Approved by the Eastern Michigan University Human Subjects Review Committee
UHSRC Protocol Number: 738343-1
Study Approval Dates: 4/16/15 – 4/15/16

Appendix C: Recruitment Flyer

Parents for Healthy Kids Project

Head Start

Head Start & Eastern Michigan University

Dear Head Start Parent,

New St. Paul Head Start is actively participating in a nutrition and health program through Eastern Michigan University called the ***Parents for Healthy Kids Project***.

This program is free and your family may be eligible to participate. By participating in this program, you will also have the opportunity to receive up to $200.

Parents for Healthy Kids Project coordinators will begin to contact eligible families starting in the next few weeks. **Please let your Head Start coordinator know if you do not wish to be contacted**. If you do not let your Head Start coordinator know that you do not wish to be contacted, you may receive a call in the near future.

Thank You!
Parents for Health Kids Team
(734) 487-1691

PHK
Parents for Healthy Kids!

Appendix D: Caregiver Demographic Questionnaire

Please tell us about yourself.

1. **Your relationship to your child?**
   ____ Mother
   ____ Father
   ____ Grandmother/grandfather
   ____ Step-mother/Step-father
   ____ Aunt/Uncle
   ____ Other(specify)________________

2. **Your age: _____years old**

3. **Your race/ethnicity (check only one)?**

   ____Black or African American
   ____Hispanic or Latino
   ____White
   ____Asian
   ____Multiracial
   ____Other (specify)________________

4. **Your highest level of education? (check only one)**
   ____Elementary or less
   ____Middle school
   ____High school
   ____College or higher

5. **Your current marital status? (check only one)**
   ____Single
   ____Married
   ____Divorced
   ____Widowed
   ____Single living with partner

6. **How many biological children do you have?**

   ______# of children

7. **How old are each of your biological children**
   (from the oldest to the youngest)?
   _____ years old (child 1)
   _____ years old (child 2)
   _____ years old (child 3)
   _____ years old (child 4)
   _____ years old (child 5)
   _____ years old (child 6)

8. **The total number of people living in your household now:**
   ______# adults
   ______# children (any under 18 year old

9. **Your current employment status:**
   ____Full-time
   ____Part-time
   ____Do not work

10. **Your annual household income in 2014 was about:**
    ____Less than $5000
    ____$5,000-$9,999
    ____$10,00-$14,999
    ____$15,000-$19,999
    ____$20,000-$29,999
    ____$30,000-$49,999
    ____$50,000 or more

11. **What type of residence do you live in?**
    ____Single family house
    ____Multi-family house
    ____Apartment
    ____Condominium/townhouse
    ____Other (specify)________________

12. **You attend religious services (church, synagogue, other)?**
    ____Weekly
    ____Occasionally
    ____Rarely
    ____Not at all

13. **Do you have any serious illnesses or other medical conditions?**
    ____Yes
    ____No

14. **IF YES, please list (up to four) of the most important illnesses or medical conditions (such as**
    high blood pressure, heart disease, asthma, arthritis, handicapped, etc.):
    ____
    ____

    ____
    ____

15. **How would you rate your overall physical health (check only one)?**
    ____Excellent
    ____Good
    ____Average
    ____Poor
    ____Extremely poor

Appendix E: Readiness Ruler

Please answer the following questions on a scale from 1 to 10, with 1 = low and 10 = high
Write the number on the line next to each question that best represents your answer.

1	2	3	4	5	6	7	8	9	10
LOW									HIGH

1. How *important* is it to you that your family makes changes toward a healthier lifestyle? _____

2. How *confident* are you that your family will make changes toward a healthier lifestyle? _____

About yourself:

On a scale from 1 to 10, with a 1 being low and a 10 being high

3. How *important* is it to you to eat more fruits and vegetables? _____

4. How *confident* do you feel that you will eat more fruits and vegetables? _____

Appendix F: Block Brief 2000 FFQ

RESPONDENT ID NUMBER

0	0	0	0	0	0	0	0	0
1	1	1	1	1	1	1	1	1
2	2	2	2	2	2	2	2	2
3	3	3	3	3	3	3	3	3
4	4	4	4	4	4	4	4	4
5	5	5	5	5	5	5	5	5
6	6	6	6	6	6	6	6	6
7	7	7	7	7	7	7	7	7
8	8	8	8	8	8	8	8	8
9	9	9	9	9	9	9	9	9

TODAY'S DATE

	DAY		YEAR
Jan			
Feb			
Mar	0	0	2000
Apr	1	1	2001
May	2	2	2002
Jun	3	3	2003
Jul		4	2004
Aug		5	2005
Sep		6	2006
Oct		7	2007
Nov		8	2008
Dec		9	2009

BRIEF FOOD QUESTIONNAIRE

This form is about the foods you usually eat.
It will take about 15 - 25 minutes to complete.

- **Please answer each question as best you can. Estimate if you aren't sure.**
- **Use only a No. 2 pencil.**
- **Fill in the circles completely, and erase completely if you make any changes.**

Please print your name in this box.

SEX
- Male
- Female

If female, are you pregnant or breast feeding?
- No
- Yes
- Not female

AGE

0	0
1	1
2	2
3	3
4	4
5	5
6	6
7	7
8	8
9	9

WEIGHT pounds

0	0	0
1	1	1
2	2	2
3	3	3
4	4	4
	5	5
	6	6
	7	7
	8	8
	9	9

HEIGHT ft. in.

ft.	in.
	00
	01
	02
3	03
4	04
5	05
6	06
	07
	08
	09
	10
	11

This form is about your usual eating habits in the past year or so. This includes all meals or snacks, at home or in a restaurant or carry-out. There are two kinds of questions for each food.

HOW OFTEN, on average, did you eat the food during the past year?
*Please DO NOT SKIP any foods. Mark "Never" if you didn't eat it.

HOW MUCH did you usually eat of the food?
*Sometimes we ask how many you eat, such as 1 egg, 2 eggs, etc., ON THE DAYS YOU EAT IT.
*Sometimes we ask "how much" as A, B, C or D. LOOK AT THE ENCLOSED PICTURES. For each food, pick the picture (bowls or plates) that looks the most like the serving size you usually eat. (If you don't have pictures: A=1/4 cup, B=1/2 cup, C=1 cup, D= 2 cups.)

EXAMPLE: This person drank apple juice twice a week, and had one glass each time. Once a week he ate a "C"-sized serving of rice (about 1 cup).

TYPE OF FOOD	HOW OFTEN IN THE PAST YEAR: NEVER	A FEW TIMES per YEAR	ONCE per MONTH	2-3 TIMES per MONTH	ONCE per WEEK	TWICE per WEEK	3-4 TIMES per WEEK	5-6 TIMES per WEEK	EVERY DAY	HOW MUCH EACH TIME (SEE PORTION SIZE PICTURES FOR A-B-C-D)				
Apple juice	○	○	○	○	○	●	○	○	○	How many glasses each time	● 1	○ 2	○ 3	○ 4
Rice	○	○	○	○	●	○	○	○	○	How much each time	○ A	○ B	● C	○ D

PLEASE DO NOT WRITE IN THIS AREA

TYPE OF FOOD	HOW OFTEN IN THE PAST YEAR									HOW MUCH EACH TIME SEE PORTION SIZE PICTURES FOR A-B-C-D				
	NEVER	A FEW TIMES per YEAR	ONCE per MONTH	2-3 TIMES per MONTH	ONCE per WEEK	TWICE per WEEK	3-4 TIMES per WEEK	5-6 TIMES per WEEK	EVERY DAY					
How often do you eat each of the following foods all year round?														
Eggs, including egg biscuits or Egg McMuffins (Not egg substitutes)	○	○	○	○	○	○	○	○	○	How many eggs each time	○ 1	○ 2	○ 3	○ 4
Bacon or breakfast sausage, including sausage biscuit	○	○	○	○	○	○	○	○	○	How many pieces	○ 1	○ 2	○ 3	○ 4
Cooked cereals like oatmeal, cream of wheat or grits	○	○	○	○	○	○	○	○	○	Which bowl		○ B	○ C	○ D
Cold cereals like Corn Flakes, Cheerios, Special K, fiber cereals	○	○	○	○	○	○	○	○	○	Which bowl		○ B	○ C	○ D
Which cereal do you eat most often? **MARK ONLY ONE:** ○ Product 19, Just Right, Total ○ Bran Buds, Raisin Bran, Fruit-n-Fiber, other fiber cereals ○ Other cold cereal, like Corn Flakes, Cheerios, Special K														
Cheese, sliced cheese or cheese spread, including on sandwiches.	○	○	○	○	○	○	○	○	○	How many slices	○ 1	○ 2	○ 3	○ 4
Yogurt (not frozen yogurt)	○	○	○	○	○	○	○	○	○	How much	○ A	○ B	○ C	○ D
How often do you eat each of the following fruits?														
Bananas	○	○	○	○	○	○	○	○	○	How many each time	○ 1/2	○ 1	○ 2	○ 3
Apples or pears	○	○	○	○	○	○	○	○	○	How many	○ 1/2	○ 1	○ 2	○ 3
Oranges, tangerines, not including juice	○	○	○	○	○	○	○	○	○	How many	○ 1/2	○ 1	○ 2	○ 3
Applesauce, fruit cocktail, or any canned fruit	○	○	○	○	○	○	○	○	○	How much	○ A	○ B	○ C	○ D
Any other fruit, like grapes, melon, strawberries, peaches	○	○	○	○	○	○	○	○	○	How much	○ A	○ B	○ C	○ D

PAGE 2

TYPE OF FOOD	HOW OFTEN IN THE PAST YEAR									HOW MUCH EACH TIME SEE PORTION SIZE PICTURES FOR A-B-C-D				
	NEVER	A FEW TIMES per YEAR	ONCE per MONTH	2-3 TIMES per MONTH	ONCE per WEEK	TWICE per WEEK	3-4 TIMES per WEEK	5-6 TIMES per WEEK	EVERY DAY					
How often do you eat each of the following vegetables, including fresh, frozen, canned or in stir fry, at home or in a restaurant?														
French fries, fried potatoes or hash browns	○	○	○	○	○	○	○	○	○	How much	○ A	○ B	○ C	○ D
White potatoes not fried, incl. boiled, baked, mashed & potato salad	○	○	○	○	○	○	○	○	○	How much	○ A	○ B	○ C	○ D
Sweet potatoes, yams, or sweet potato pie	○	○	○	○	○	○	○	○	○	How much	○ A	○ B	○ C	○ D
Rice, or dishes made with rice	○	○	○	○	○	○	○	○	○	How much	○ A	○ B	○ C	○ D
Baked beans, chili with beans, pintos, any other dried beans	○	○	○	○	○	○	○	○	○	How much	○ A	○ B	○ C	○ D
Refried beans	○	○	○	○	○	○	○	○	○	How much	○ A	○ B	○ C	○ D
Green beans or green peas	○	○	○	○	○	○	○	○	○	How much	○ A	○ B	○ C	○ D
Broccoli	○	○	○	○	○	○	○	○	○	How much	○ A	○ B	○ C	○ D
Carrots, or stews or mixed vegetables containing carrots	○	○	○	○	○	○	○	○	○	How much	○ A	○ B	○ C	○ D
Spinach, or greens like collards	○	○	○	○	○	○	○	○	○	How much	○ A	○ B	○ C	○ D
Cole slaw, cabbage	○	○	○	○	○	○	○	○	○	How much	○ A	○ B	○ C	○ D
Green salad	○	○	○	○	○	○	○	○	○	How much	○ A	○ B	○ C	○ D
Raw tomatoes, including in salad	○	○	○	○	○	○	○	○	○	How much	○ 1/4	○ 1/2	○ 1	○ 2
Catsup, salsa or chile peppers	○	○	○	○	○	○	○	○	○	How many TBSP.	○ 1	○ 2	○ 3	○ 4
Salad dressing or mayonnaise (Not low fat)	○	○	○	○	○	○	○	○	○	How many TBSP.	○ 1	○ 2	○ 3	○ 4
Any other vegetable, like corn, squash, okra, cooked green peppers, cooked onions	○	○	○	○	○	○	○	○	○	How much	○ A	○ B	○ C	○ D
Vegetable soup, vegetable beef, chicken vegetable, or tomato soup	○	○	○	○	○	○	○	○	○	Which bowl		○ B	○ C	○ D

PAGE 3

PLEASE DO NOT WRITE IN THIS AREA

TYPE OF FOOD	HOW OFTEN IN THE PAST YEAR: NEVER	A FEW TIMES per YEAR	ONCE per MONTH	2-3 TIMES per MONTH	ONCE per WEEK	TWICE per WEEK	3-4 TIMES per WEEK	5-6 TIMES per WEEK	EVERY DAY	HOW MUCH EACH TIME (SEE PORTION SIZE PICTURES FOR A-B-C-D)				
MEATS														

Do you ever eat chicken, meat or fish? ○ Yes ○ No IF NO, SKIP TO NEXT PAGE

TYPE OF FOOD	NEVER	A FEW TIMES per YEAR	ONCE per MONTH	2-3 TIMES per MONTH	ONCE per WEEK	TWICE per WEEK	3-4 TIMES per WEEK	5-6 TIMES per WEEK	EVERY DAY	HOW MUCH EACH TIME				
Hamburgers, cheeseburgers, meat loaf, at home or in a restaurant	○	○	○	○	○	○	○	○	○	How much meat	○ 1/8 lb.	○ 1/4 lb.	○ 1/2 lb.	○ 3/4 lb.
Tacos, burritos, enchiladas, tamales	○	○	○	○	○	○	○	○	○	How much	○ A	○ B	○ C	○ D
Beef steaks, roasts, pot roast, or in frozen dinners or sandwiches	○	○	○	○	○	○	○	○	○	How much	○ A	○ B	○ C	○ D
Pork, including chops, roasts, or dinner ham	○	○	○	○	○	○	○	○	○	How much	○ A	○ B	○ C	○ D

When you eat beef or pork, do you ○ Avoid eating the fat ○ Sometimes eat the fat ○ Often eat the fat ○ I don't eat meat

TYPE OF FOOD	NEVER	A FEW TIMES per YEAR	ONCE per MONTH	2-3 TIMES per MONTH	ONCE per WEEK	TWICE per WEEK	3-4 TIMES per WEEK	5-6 TIMES per WEEK	EVERY DAY	HOW MUCH EACH TIME				
Mixed dishes with meat or chicken, like stew, corned beef hash, chicken & dumplings, or in frozen meals	○	○	○	○	○	○	○	○	○	How much	○ A	○ B	○ C	○ D
Fried chicken, at home or in a restaurant	○	○	○	○	○	○	○	○	○	# medium pieces	○ 1	○ 2	○ 3	○ 4
Chicken or turkey not fried, such as baked, grilled, or on sandwiches	○	○	○	○	○	○	○	○	○	How much	○ A	○ B	○ C	○ D

When you eat chicken, do you ○ Avoid eating the skin ○ Sometimes eat the skin ○ Often eat the skin ○ N/A

TYPE OF FOOD	NEVER	A FEW TIMES per YEAR	ONCE per MONTH	2-3 TIMES per MONTH	ONCE per WEEK	TWICE per WEEK	3-4 TIMES per WEEK	5-6 TIMES per WEEK	EVERY DAY	HOW MUCH EACH TIME				
Fried fish or fish sandwich, at home or in a restaurant	○	○	○	○	○	○	○	○	○	How much	○ A	○ B	○ C	○ D
Any other fish or shellfish not fried, including tuna	○	○	○	○	○	○	○	○	○	How much	○ A	○ B	○ C	○ D
Hot dogs, or sausage like Polish, Italian or Chorizo	○	○	○	○	○	○	○	○	○	How many	○ 1	○ 2	○ 3	○ 4
Boloney, sliced ham, turkey lunch meat, other lunch meat	○	○	○	○	○	○	○	○	○	How many slices	○ 1	○ 2	○ 3	○ 4

When you eat lunch meats, are they ○ Usually low-fat ○ Sometimes ○ Rarely low-fat ○ N/A

PLEASE DO NOT WRITE IN THIS AREA

TYPE OF FOOD	NEVER	A FEW TIMES per YEAR	ONCE per MONTH	2-3 TIMES per MONTH	ONCE per WEEK	TWICE per WEEK	3-4 TIMES per WEEK	5-6 TIMES per WEEK	EVERY DAY	HOW MUCH EACH TIME SEE PORTION SIZE PICTURES FOR A-B-C-D				
Pasta, breads, spreads, snacks														
Spaghetti, lasagna, or other pasta with tomato sauce										How much	A	B	C	D
Cheese dishes without tomato sauce, like macaroni and cheese										How much	A	B	C	D
Pizza, including carry-out										How many slices	1	2	3	4
Biscuits, muffins										How many each time	1	2	3	4
Rolls, hamburger buns, English muffins, bagels										How many each time	1/2	1	2	3
White bread or toast, including French, Italian, or in sandwiches										How many slices	1	2	3	4
Dark bread like rye or whole wheat, including in sandwiches										How many slices	1	2	3	4
Tortillas										How many each time	1	2	3	4
Margarine on bread, potatoes or vegetables										How many pats (Tsp.)	1	2	3	4
Butter on bread, potatoes or vegetables										How many pats (Tsp.)	1	2	3	4
Peanuts or peanut butter										How many TBSP.	1	2	3	4
Snacks like potato chips, corn chips, popcorn (Not pretzels)										How much	A	B	C	D
Doughnuts, cake, pastry, pie										How many pieces	1	2	3	4
Cookies (Not lowfat)										How many	1-2	3-5	6-7	8+
Ice cream, frozen yogurt, ice cream bars										How much	A	B	C	D
When you eat ice cream or frozen yogurt, is it	Usually low-fat			Sometimes			Rarely low-fat			N/A				
Chocolate candy, candy bars										How many bars	1 small	1 medium	1 large	2 large

PAGE 5

TYPE OF BEVERAGE	HOW OFTEN IN THE PAST YEAR: NEVER	A FEW TIMES per YEAR	ONCE per MONTH	2-3 TIMES per MONTH	ONCE per WEEK	TWICE per WEEK	3-4 TIMES per WEEK	5-6 TIMES per WEEK	EVERY DAY	HOW MUCH EACH TIME SEE PORTION SIZE PICTURES FOR A-B-C-D				
How often do you drink the following beverages?														
Real orange or grapefruit juice, Welch's grape juice, Minutemaid juices, Juicy Juice	○	○	○	○	○	○	○	○	○	How many glasses each time	○ 1	○ 2	○ 3	○ 4
Hawaiian Punch, Sunny Delight, Hi-C, Tang, or Ocean Spray juices	○	○	○	○	○	○	○	○	○	How many glasses each time	○ 1	○ 2	○ 3	○ 4
Kool Aid, Capri Sun or Knudsen juices	○	○	○	○	○	○	○	○	○	How many glasses each time	○ 1	○ 2	○ 3	○ 4
Instant breakfast milkshakes like Carnation, diet shakes like Slimfast, or liquid supplements like Ensure	○	○	○	○	○	○	○	○	○	How many glasses or cans	○ 1	○ 2	○ 3	○ 4
Glasses of milk (any kind)	○	○	○	○	○	○	○	○	○	How many glasses	○ 1	○ 2	○ 3	○ 4
When you drink glasses of milk what kind do you <u>usually</u> drink? **MARK ONLY ONE:**	○ Whole milk ○ Reduced fat 2% milk ○ Low-fat 1% milk				○ Non-fat milk ○ Rice milk ○ Soy milk				○ I don't drink milk or soy milk					
Cream, Half-and-Half or non-dairy creamer in coffee or tea	○	○	○	○	○	○	○	○	○	Total TBSP. on those days	○ 1	○ 2	○ 3-4	○ 5+
Regular soft drinks, or bottled drinks like Snapple (<u>Not</u> diet drinks)	○	○	○	○	○	○	○	○	○	How many bottles or cans	○ 1	○ 2	○ 3-4	○ 5+
Beer	○	○	○	○	○	○	○	○	○	How many bottles or cans	○ 1	○ 2	○ 3-4	○ 5+
Wine or wine coolers	○	○	○	○	○	○	○	○	○	How many glasses	○ 1	○ 2	○ 3-4	○ 5+
Liquor or mixed drinks	○	○	○	○	○	○	○	○	○	How many drinks	○ 1	○ 2	○ 3-4	○ 5+

PAGE 6

During the past year, have you taken any vitamins or minerals regularly, at least once a month?

○ No, not regularly ○ Yes, fairly regularly

(IF YES) WHAT DID YOU TAKE FAIRLY REGULARLY?

VITAMIN TYPE	HOW OFTEN					FOR HOW MANY YEARS?					
	DIDN'T TAKE	A FEW DAYS per MONTH	1-3 DAYS per WEEK	4-6 DAYS per WEEK	EVERY DAY	LESS THAN 1 YR.	1 YEAR	2 YEARS	3-4 YEARS	5-9 YEARS	10+ YEARS
Multiple Vitamins. Did you take…											
Regular Once-A-Day, Centrum, or Thera type	○	○	○	○	○	○	○	○	○	○	○
Stress-tabs or B-Complex type	○	○	○	○	○	○	○	○	○	○	○
Antioxidant combination type	○	○	○	○	○	○	○	○	○	○	○
Single Vitamins (not part of multiple vitamins)											
Vitamin A (not beta-carotene)	○	○	○	○	○	○	○	○	○	○	○
Beta-carotene	○	○	○	○	○	○	○	○	○	○	○
Vitamin C	○	○	○	○	○	○	○	○	○	○	○
Vitamin E	○	○	○	○	○	○	○	○	○	○	○
Folic acid, folate	○	○	○	○	○	○	○	○	○	○	○
Calcium or Tums, alone or combined with vit. D or magnesium	○	○	○	○	○	○	○	○	○	○	○
Zinc	○	○	○	○	○	○	○	○	○	○	○
Iron	○	○	○	○	○	○	○	○	○	○	○
Selenium	○	○	○	○	○	○	○	○	○	○	○
Vitamin D, alone or combined with calcium	○	○	○	○	○	○	○	○	○	○	○

If you took vitamin C or vitamin E:

How many milligrams of **vitamin C** did you usually take, on the days you took it?

○ 100 ○ 250 ○ 500 ○ 750 ○ 1000 ○ 1500 ○ 2000 ○ 3000+ ○ don't know

How many IUs of **vitamin E** did you usually take, on the days you took it?

○ 100 ○ 200 ○ 300 ○ 400 ○ 600 ○ 800 ○ 1000 ○ 2000+ ○ don't know

How often do you use fat or oil in cooking?

○ Less than once per week ○ A few times per week ○ Once a day ○ Twice a day ○ 3+ per day

What kinds of fat or oil do you usually use in cooking? MARK ONLY ONE OR TWO

○ Don't know, or Pam
○ Stick margarine
○ Soft tub margarine
○ Butter
○ Butter/margarine blend
○ Low-fat margarine
○ Corn oil, vegetable oil
○ Olive oil or canola oil
○ Lard, fatback, bacon fat
○ Crisco

Did you ever drink more beer, wine or liquor than you do now? ○ Yes ○ No

Do you smoke cigarettes now? ○ Yes ○ No

IF YES, On the average about how many cigarettes a day do you smoke now?

○ 1-5 ○ 6-14 ○ 15-24 ○ 25-34 ○ 35 or more

What is your ethnic group? (MARK ONE OR MORE)

○ Hispanic or Latino
○ White, not Hispanic
○ Black or African American
○ Asian
○ American Indian or Alaska Native
○ Native Hawaiian or Other Pacific Islander

Thank you very much for filling out this questionnaire. Please take a minute to go back and fill in anything you may have skipped.

PLEASE DO NOT WRITE IN THIS AREA

PAGE 7

FOOD QUESTIONNAIRE

Serving Size Choices

Keep this in front of you while you are filling out The Food Questionnaire. You may use <u>either the plates or the bowls</u> to help you choose your serving size.

Choose A, B, C or D: **A** = 1/4 Cup of Food **B** = 1/2 Cup of Food **C** = 1 Cup of Food **D** = 2 Cups of Food