

“PARA I FAMAGU’ON-TA”: FRUIT AND VEGETABLE INTAKE, FOOD STORE ENVIRONMENT, AND  
CHILDHOOD OVERWEIGHT/OBESITY ON GUAM

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## DEDICATION

This thesis is dedicated to my family, who has motivated me from the very start, to expand my knowledge base and pursue my academic/career goals. First and foremost, I thank God the Father for blessing me with gifts to learn and share in the love that He bestows. To my dad, Daniel C. Matanane, you are my rock, my number 1 fan in life, and everything of the type of leader that I strive to be. As the saying goes, "I am my father's child." To my mom, Elizabeth R. Matanane, I am humbled by the values that you instilled in me to serve others before myself. To my grandmother, Fidela C. Matanane, you are the most soft-hearted and hardest working woman that I will ever know. I wish to have your work ethic in the upcoming decades. To my brother, Tim, who inspires me to be authentic and dauntless in everything that I do. You are the secret weapon to much of my success. Last but not least, to my boyfriend, Elijah Reyes, you endured many sacrifices to support my career goals, which included spending the past few years in distance. I am a better person for having you in my life and take comfort in the belief that, "Good things come to those who wait", as we move onto the next chapter of our lives together.

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## ABSTRACT

**BACKGROUND:** Many studies support the influential role that the food store environment (FSE) has on children's dietary intake and weight status.

**PURPOSE:** To test if availability and access to fruits and vegetables (FV) in food stores is associated with prevalence of early childhood (2 – 8 years) overweight/obesity ( $\geq 85^{\text{th}}$  BMI percentile) in selected communities on Guam; To test if actual FV intake of young children influences the relationship between the FSE and early childhood overweight/obesity prevalence.

**METHODS:** FSE factors, including fresh FV score and presence of store by store type were assessed using the CX<sup>3</sup> Food Availability and Marketing Survey that was amended for the Children's Healthy Living (CHL) Program community trial and measured at baseline. Anthropometry and characteristic data of children (2 to 8 years; n=466) were collected across all communities and BMI z-scores and categories calculated using the 2000 CDC growth charts. Geographic coordinates of participant residences and food stores were obtained to construct ArcGIS maps and to calculate food store scores within 1 mile of participant residence. Food and Activity Logs (FAL) data of a sub-sample of child participants (n = 355) were collected to calculate FV and energy intakes. Bivariate correlations and logistic regression evaluated associations.

**RESULTS:** A total of 111 stores were surveyed of which the majority was small markets (73%) and the remaining were convenience stores (16%) and large grocery/supermarkets (11%). Supermarkets and large grocery stores averaged the highest FV scores that met the standards for availability. About 1/5<sup>th</sup> and 1/10<sup>th</sup> of participants met fruit and vegetable intake recommendations, respectively, while nearly half of them exceeded recommendations for energy intake. A significant negative correlation was found between presence of small market nearest to participant residence and BMI z-score ( $r = -0.129$ ,  $p < 0.05$ ); and positive correlation found between presence of convenience store nearest to participant residence and BMI z-score ( $r = 0.092$ ,  $p < 0.05$ ). Logistic regression analysis yielded non-significant associations.

**CONCLUSION:** High density of small markets may be an opportunity for FSE intervention but further investigations of other FSE factors with more communities are needed to understand the FSE's influence on Guam.

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## CHAPTER 1: LITERATURE REVIEW

### CHILDHOOD OVERWEIGHT/OBESITY (COWOB) EPIDEMIC

#### **Global COWOB**

Childhood overweight/obesity (COWOB) is a growing global epidemic affecting countries with available data. The number of overweight and obese children around the world, including the countries of England, Australia, Germany, Iceland, Scotland, Chile, Japan, Canada, Brazil, Finland, Greece, Spain, and the United States of America (US), has increased from the 1970's to the early 2000's (Butland, Jebb, & Kopelman, 2007; Kotani, Nishida, & Yamashita, 1997; Wang & Lobstein, 2006). Global COWOB prevalence overall is estimated at approximately 10% or 170 million children ages 5 to 17 years (Lobstein, Baur, & Uauy, 2004). In the US, the current estimate of overweight/obesity prevalence in children, ages 2 to 19 years is approximately 32% (Ogden, Carroll, Kit, & Flegal, 2012, 2014).

#### **Double-burden in Developing Countries**

The impact of COWOB, however, is not limited to developed countries. Initially, high prevalence of COWOB surfaced in economically developed countries and in urban populations, but has eventually spread to developing countries and rural populations. In 2010, the World Health Organization (WHO) estimated that of the over 42 million children under the age of 5 years were classified as overweight or obese, close to 35 million of them lived in developing countries (WHO, 2014), surpassing the number of underweight children. Developing countries

and rural populations are experiencing a double-burden of overweight/obesity and underweight, where undernutrition and its related diseases still occur (Mo-suwan, 2008). The data demonstrate that there is a coexistence of underweight and overweight across and within developing countries.

### **Influential Factors of COWOB**

Poor diet and activity levels are recognized as direct behavioral factors that influence energy imbalance leading to COWOB (Butland et al., 2007). Poor diet can be attributed to infant feeding, energy dense foods, sugar-sweetened beverages, portion sizes, or a combination of these elements (Lobstein et al., 2004). In terms of activity levels, decreasing energy expenditure pertains to the frequency, safety, and enjoyment of physical activity, in families, schools, and communities (Goran, Reynolds, & Lindquist, 1999). Other behavioral factors linked to COWOB are sleep, as in too little sleep and impaired sleep quality, and sedentary time (e.g., screen time, inactivity) (Gable et al., 2007; Must & Parisi, 2009). Genetic factors, such as congenital leptin deficiency, have also been shown to affect individual biological responses to diet and physical activity, but are quite rare (Farooqi, 2005). Epigenetics and fetal programming from maternal obesity has also been shown to negatively affect fetal gene expression by increasing fetal inflammation and hepatic lipids from fetal lipid exposure, which increases risk factors for COWOB and non-communicable diseases (NCDs) (Heerwagen, Miller, Barbour, & Friedman, 2010).

Environmental determinants of COWOB are multi-fold and include policy/economic (e.g., rules, costs), physical/built (e.g., availability, accessibility), and social/cultural (e.g.,

attitudes, beliefs) domains (Fialkowski et al., 2013; Swinburn et al., 1999). Researchers consider the “built environment” to consist of the neighborhoods, roads, buildings, food sources, and recreational facilities in which people live, work, are educated, eat, and play (Sallis & Glanz, 2006). Thus, an obesogenic environment is “the sum of influences that the surroundings, opportunities, or conditions of life have on promoting obesity in individuals or populations,” (Swinburn, Egger, & Raza, 1999). An example of an obesogenic environment is the modern food system, which provides an abundant supply of food that is cheap, palatable, energy-dense, highly marketed, and widely distributed (Kitchen, Brignell, Li, & Jones, 2004; Swinburn et al., 2011). Likewise, transportation systems, physical infrastructure, and access to facilities and opportunities for physical activity can affect physical activity levels in children and contribute to the obesogenic environment (Popkin et al., 2005; Sallis & Glanz, 2006).

Socioeconomic status also contributes to COWOB and obesity-related diseases. Factors such as socio-demographic, cultural and family practices, income, and education have been associated with race/ethnic disparities in weight status of children (Galván, Uauy, López-Rodríguez, & Kain, 2014; Griffiths, Dezateux, & Cole, 2011; Ogden, Lamb, Carroll, & Flegal, 2010; Weden & Brownell, 2012). The social/cultural environment refers to the community’s or society’s attitudes, beliefs and values related to eating and physical activity behaviors and varies by culture and belief systems (Swinburn et al., 1999). Few studies have shown that the prevalence of COWOB has leveled off in Australia, Europe, Japan and the US, but not without socioeconomic disparities (Moss et al., 2011; Ogden et al., 2012; Sundblom et al., 2008).

### **Consequences of COWOB**

The adverse health outcomes of COWOB vary in both physical and psychosocial well-being. COWOB and its related conditions can have immediate consequences in childhood, and/or chronic long term effects. The most notable consequence of COWOB is that it is an established risk factor for NCDs (Daniels, 2006). NCDs include but are not limited to cardiovascular disease, type 2 diabetes, and many types of cancers. NCDs are now the leading cause of preventable disease burden in low-and-middle income countries (Lopez, Mathers, Ezzati, Jamison, & Murray, 2006). COWOB increases the risk of adult obesity and of developing NCDs in adulthood (Chu & Choe, 2010; Nader et al., 2006; Saha, Eckert, Pratt, & Shankar, 2005).

The physical consequences of obesity involve direct damage to the cardiovascular (e.g., hypertension, left ventricular hypertrophy, atherosclerosis) and metabolic (e.g., insulin resistance, dyslipidemia, metabolic syndrome, type 2 diabetes) systems (Daniels, 2006; Rosner, Prineas, & Daniels, 2000). Historically, these conditions were thought to have predominant onsets in adulthood but have been diagnosed in children more recently. Other disorders related to COWOB can affect the pulmonary (asthma, obstructive sleep apnea), gastrointestinal (nonalcoholic fatty liver disease, gastroesophageal reflux), and skeletal (tibia vara, slipped capital-femoral epiphysis) systems (Daniels, 2006).

Several studies have examined the psychosocial consequences of COWOB that can negatively influence future health outcomes. These consequences include but are not limited to associations with lowered self-esteem, depression, isolation, impaired quality of life, social skill and interpersonal relationship deficits, disordered eating symptoms, academic problems, suicidal behaviors, and weight stigmatization (i.e., weight-related attitudes and beliefs that are

manifested by stereotypes, bias, rejection and prejudice) (Hartmann & Hilbert, 2013; Puhl & Latner, 2007). The stigmatization of obesity has also been shown to be more negative in children than in adults, which suggests that the youth develop less negative attitudes of obesity in adulthood (Latner, Stunkard, & Wilson, 2005). However, damaging social-emotional wellbeing in childhood may have lasting effects in shaping behaviors well into adulthood.

There is a growing body of evidence suggesting that weight stigmatization may mediate the relationship between weight and psychological health (Cattarin, 1994; Davison & Birch, 2002; Puhl & Latner, 2007). This means that psychosocial issues, such as self-esteem, depression, and quality of life, are not dependent on children's weight but of others' (e.g., peers, parents, teachers) reactions to these children. However, the causal pathway between psychosocial health and COWOB has yet to be established.

### **Defining Overweight or Obese in Children**

The purpose of defining overweight or obesity in children is to assess health risks, as well as to compare populations at risk for nutrition and health conditions. Evaluating the combination of anthropometric indices is essential to defining overweight and obesity as body weight alone is meaningless unless it is related to an individual's age or height (Group, 1986; Organization, 1995). Some examples of anthropometric indices used in assessing children are weight-for-height, height-for-age, and weight-for-age, whereby weight is related to height through the use of reference data.

The most commonly applied method for determining COWOB is Body Mass Index (BMI). BMI is an indirect measurement for estimating body composition based on weight for height

kg/m<sup>2</sup>) that does not consider a percentage for lean body mass or body fat (Lobstein et al., 2004; Organization, 1995). It is a screening tool used to measure weight status around the world both clinically and in population studies. There are multiple governing bodies, including the Center of Disease Control and Prevention (CDC), World Health Organization (WHO), and the World Obesity Federation (formerly the International Obesity Task Force) that have identified cut-off values that identify at-risk children (Cole et al., 2000).

The CDC growth reference for defining COWOB originates from the 1977 National Center for Health Statistics (NCHS) growth curves for children ages 2 to 18 years. These growth curves were based on data from the Fels Longitudinal Growth Study of predominantly formula-fed, white middle-class infants from Ohio (RJ Kuczmarski, Ogden, & Grummer-Strawn, 2000). The 1977 NCHS growth curves were revised in 1978 and based on nationally representative cross-sectional data collected from the National Health Examination Survey (NHES) Cycle II (1963-1965) for ages 6 to 11 years and NHES III (1966-1970) for ages 12 to 17 years, as well as the first National Health and Nutrition Examination Survey (NHANES I) (1971-1974) for ages 1 to 17 years (Hegsted et al., 1974; R. J. Kuczmarski et al., 2002). The most recent and current reference data is the 2000 CDC Growth Charts for children ages 2 to 20 years, which includes the previous nationally representative data (i.e., NHES II, NHES III, NHANES I), in addition to data from NHANES II (1976-1980) for ages six months to 19 years and NHANES III (1988-1994) for children ages 2 months to 19 years. This reference data set represents growth patterns of combined breastfed and formula-fed infants in the population with embedded smooth transitions between related charts (Kuczmarski et al., 2000). The 2000 CDC Growth Charts for the US classifies children ages 2 to 19 with a BMI-for-age that is  $\geq 85^{\text{th}}$  and  $< 95^{\text{th}}$  percentile as

overweight and  $\geq 95^{\text{th}}$  percentile as obesity (CDC, 2013).

The WHO Child Growth Standards use z-scores to monitor growth, although z-scores can also be calculated with the 2000 CDC Growth Charts. In the WHO standards, to plot a weight-for-height score, a z-score of 0 is equivalent to the median or  $50^{\text{th}}$  percentile while a z-score of +1 or +2 standard deviation (SD) of a reference constitutes overweight or obesity, respectively (Lobstein et al., 2004; Study, 2006). Unlike the 2000 CDC Growth Charts that serve as a growth reference to a population of children in a particular place and time where formula feeding was common, the 2006 WHO standards for children ages <5 years are based on data from the WHO Multicentre Growth Reference Study (MGRS) (1997-2003) of children from birth to 23 months, and further study from 24 to 59 months, who were growing in optimal conditions (e.g., all breast fed) from six countries: Brazil, Ghana, India, Norway, Oman, and the US. Therefore, the 2006 WHO growth curves for children ages <5 years are regarded as the international growth standard (CDC, 2010, 2013). The WHO growth curves also include reference data for children and adolescents ages 5 to 19 years that closely align with the WHO Child Growth Standards (de Onis et al., 2007). Recommendations in the US are to use 2006 WHO Growth Standards for children ages <24 months and to use the 2000 CDC Growth Charts for children ages 2 to 19 years as the WHO and CDC growth curves for children ages 2 to 5 years are similar (CDC, 2010).

The World Obesity Federation growth reference data used internationally pooled data to develop BMI centile curves that pass through adult cut-off points, so that a BMI of 25 and 30 defines overweight and obesity (Cole et al., 2000; WANG & LOBSTEIN, 2006). The data are based on nationally representative data of children ages 2 to 18 years from the countries of Brazil, Great Britain, Hong Kong, the Netherlands, Singapore, and the US (Cole et al., 2000). This

definition of COWOB corresponds with adult BMI cut off points, so that essentially, all ages are covered in this method.

Although BMI is an inexpensive anthropometric method useful in identifying obesity prevalence, it has the potential to pose disparities among different ethnicities. There is ongoing debate as to the use of universal BMI cut-off points and reference data or the use ethnic specific cut-off points to improve diagnostic accuracy to determine COWOB. A study of BMI thresholds in five ethnicities: European, Maori, Pacific Island, East Asian, and South Asian, found Pacific Islanders to have the lowest percentage body fat for a given BMI of all the ethnic groups (Duncan & Duncan, 2009). Data from the study identified East Asian girls having the lowest sensitivity (65.7%) of BMI to body fat and Pacific Island girls having the lowest specificity (42.6%) to current BMI standards. Duncan et al. (2009) stated that, "greater than a third of East Asian girls with normal levels of body fat were incorrectly categorized as overweight," (p.408) based on BMI. The inconsistency of defining at-risk populations puts ethnic groups like Pacific Islanders, who are already subject to additional socioeconomic risk factors, at a disadvantage.

However, a universal BMI standard limits the complexity of classifying overweight and obesity, as genetic makeup today is often a combination of ethnicities (e.g., Pacific Islander and Asian) and different cut-off points may be difficult to distinguish for individuals of mixed ethnic backgrounds (Duncan & Duncan, 2009). If separate cut-off points are used to measure different race/ethnic groups, then making comparisons across ethnic groups becomes difficult.

Other indirect measurements of body fatness include skinfold thickness, waist circumference, and waist-to-hip ratio. These methods are useful in identifying children with

moderately elevated levels of BMI (85<sup>th</sup> to 94<sup>th</sup> percentiles) who have excess adiposity or other risk factors (Freedman & Sherry, 2009). Direct methods for assessing body composition include underwater weighing, magnetic resonance imaging, computerized axial tomography, dual-energy x-ray absorptiometry, bioelectrical impedance analysis, and air-displacement plethysmography, which are used mainly for validity in research as a 'gold standard' against other anthropometric measures (Goran, 1998; Lobstein et al., 2004). With the exception of bioelectrical impedance analysis, these methods are most applicable to the clinical environment.

### THE PACIFIC REGION

The Pacific Region in its entirety is better known as Oceania (Figure 1) and encompasses more than 10,000 tropical islands scattered throughout most of the Pacific Ocean (Encyclopaedia Britannica, 2014). The region of Oceania is located between Asia and the Americas and is further divided into 3 sub-regions: Melanesia, Micronesia, and Polynesia. Oceania spans approximately 317,700 square miles, in addition to the Australia continent (Encyclopaedia Britannica, 2014).

#### **The US Affiliated Pacific Island**

The US Affiliated Pacific Islands (USAPI) includes the following jurisdictions: American Samoa, Commonwealth of the Northern Mariana Islands, Federated States of Micronesia, Guam, Republic of Palau, and the Republic of the Marshall Islands (Figure 2). There are limited data that describes COWOB in the USAPI which, if even reported, is typically underrepresented and is aggregated as a Native Hawaiian and Pacific Islander (NHPI) group across jurisdictions. A

systematic review comparing COWOB prevalence ages 2 to 8 years in selected regions of the US Affiliated Pacific (USAP) (i.e., Alaska, American Samoa, CNMI, Federated States of Micronesia, Guam and Hawai'i) and the 48 contiguous US states, which is comprised of White, Hispanic, Blacks, Mexican Americans, and other race/ethnic groups, finds a two-fold increase in COWOB from ages 2 (21%) to 8 (39%) years in the USAP, compared to their contiguous US counterparts, from ages 2 (24%) to 8 (35%) years (Novotny et al., 2014).

Aside from children, the high prevalence of obesity and NCDs in USAPI adult populations has already elicited global attention (Secretariat of the Pacific Community, 2010). The Pacific Island Health Officers Association (PIHOA), a non-profit organization led by and representing the collective interests of the Ministers, Secretaries, and Directors of Health of the USAPI, in 2010 signed Board Resolution No. 48-01, "Declaring a Regional State of Health Emergency due to the epidemic of NCDs in the USAPI," (Pacific Islands Health Officers Association, United States Affiliated Pacific Islands, 2010). A recent assessment of NCDs and related risk factors on Guam reveals the adult population on Guam as 35.4% overweight (BMI of 25 – 29.9) and 25.9% obese (BMI  $\geq$  30) (Ichiho, Gillan, & Aitaoto, 2013).

## **Guam**

The island of Guam is an organized, unincorporated territory of the US and is located in the Western Pacific Ocean as part of the Micronesia region of Oceania. Guam is 13.28 degrees north latitude, 144.47 degrees east longitude, about 1,500 miles east of Japan and 3,800 miles west of Hawai'i. The island of Guam is a 210 square miles. The longest point of the island is 30 miles and the narrowest to widest parts of the island range from 4 to 12 miles. Guam is the

largest, most populated, and southernmost island of the Mariana Islands chain (Central Intelligence Agency, 2014; Encyclopaedia Britannica, 2014; Karolle, 2014).

The island's geographic location between Asia and North America is of strategic importance for military positioning with a combination of European, Asian and American influences throughout the island's history up to the present (Guampedia, 2014). According to the 2010 Census, 159,358 people live on Guam. The indigenous Chamorro (also written as *Chamoru*) people comprise 37% of Guam's population. Filipinos comprise 26% of the population, while other Pacific Islander, Asian, White, and mixed races make up the remainder in smaller proportions (US Census Bureau, 2012). The median age is 29.5 years, the male and female distribution is 51.1% and 48.9%, respectively. The 2009 mean household income is \$60,671. Pre-kindergarten and kindergarten children (ages 3 – 5 years) account for 11.1% out of the 39,536 children 3 years of age and over that are enrolled in school from pre-kindergarten to grade 12. In the adult population of 25 years of age and older, 79% of adults have a high school diploma or higher and 18% have a bachelor's degree or higher (US Census Bureau, 2012).

### **History of Guam**

Guam has seven historical eras documented to date (Figure 3). Archaeological evidence indicates that the first inhabitants of Guam and the Mariana Islands settled over 4,000 years ago (2,000 BC) and evolved into the Chamorro people with a unique culture and language (Cunningham, 1992; Guampedia, 2014a). During the Ancient Chamorro Era, Chamorros developed distinct *latte* stone structures, some of which still stand today, and pottery forms, in addition to everyday tools made of bone, stone, shell and clay (Cunningham, 1992). Gender

roles were specific and harmonious between the people, land, resources, and spirits.

The first Spanish visitors arrived on Guam in 1521 with Ferdinand Magellan but actual colonization began with missionaries, led by Padre Sanvitores from Spain, in 1668 (Cunningham, 1992). For almost 300 years, the Spanish Era (1668-1898) colonized Guam and the rest of the Mariana Islands and incorporated Catholicism and the Spanish language into the Chamorro culture and way of life (Guampedia, 2014b).

American influence on the Chamorro people started when Guam was annexed via the Treaty of Paris as a result of the Spanish-American War. The US Naval Era (1898 – 1941) lasted until the Japanese bombed the island on December 8, 1941, on the way to Hawai'i, which is better known historically from the infamous attack on Pearl Harbor. The Japanese (1941-1944) occupied Guam during most of World War II, until 1944, when the US military regained control over Japan (Guampedia, 2014b).

The Post War Era (1944-1950) included many changes in land rights through displacement of Chamorros to build military bases (Guampedia, 2014b). Further acculturation goals of the US sought to impose various social norms (Underwood, 1987). For example, Chamorro adults and children were constrained to speak English (Lujan, 2014). The food system shifted to increasing amounts of imported foods, as adults and parents were encouraged to work in jobs putting less emphasis on the land and subsistence living (Underwood, 1987).

In 1950, Congress signed the Organic Act, which was later amended in 1968, and coined the term “Guamanian” to refer to people of any race and ethnicity who called Guam their home (Guampedia, 2014a). Guamanians were thus granted US citizenship and were allowed to setup

a local administration in the Guamanian Era (1950-1970). Additionally, the Compact Impact was signed to allow neighboring Micronesians from the Federated States of Micronesia (Chuuk State, Kosrae State, Pohnpei State, Yap State), the Republic of Palau, and the Republic of the Marshall Islands free access to Guam's resources.

The Modern Guam Era (1970 to present) was initiated with the first elected governor, Carlton S. Skinner, and soon after sent one nonvoting delegate to the US House of Representatives (Guampedia, 2014b; Rogers, 1995). Currently, there is ongoing debate as to the relocation of military bases from Okinawa to Guam in what has been termed, the Military Buildup (Natividad & Kirk, 2010). In question is whether the island's infrastructure will support the population influx, what are the possible benefits to local economy, and how the build-up will affect the indigenous Chamorro people. The integrated mode of acculturation that maintains high affiliation with ethnic (Chamorro) heritage and mainstream (American) culture challenges Chamorro core values such as *inafa'maolek* (interdependence), *mamahlaho* (attitude of deference for others), and controls on *champåda* (competition for status) with American values of self-reliance, individualism, and pursuit of success in reaching one's full potential (Berry, 2003; Cunningham, 1992). To date, Chamorros on Guam are still struggling for self-determination in as much as they are struggling to hold on to their Chamorro identity (MP Perez, 2002; M. P. Perez, 1993; Underwood, 1990).

### **The Influence of History on the Chamorro Diet**

The historical events on Guam have influenced the culture and practices of the Chamorro people. Food choices, food preparations methods, and other daily activities have

evolved over time influencing the composition of the modern diet of the Chamorro people. The pre-colonial diet of the Chamorros was predominantly plant-based, supplemented with animal foods comprised mostly of fish, crustaceans, fruit bat and birds (Cassels, 2006). Methods of food preparation involved the use of the earth oven, pottery, salt or citrus in a subsistence food system (Cunningham, 1992; Salas & Tolentino, 2013). For Chamorros, the sharing of food was a significant element of culture and body nourishment, wherein men and women had key roles in gathering and preparing meals (Cunningham, 1992; Marsh, 2014). At a certain age, the *famagu'on* (children) were initiated to learn and work alongside their parents and older family members. Subsistence living, such as farming, fishing, hunting, roof thatching, woodcutting, creating pottery, and preparing food, involved physical activities for men, women, and children alike (Marsh, 2014).

The arrival of Spanish colonizers in 1668 brought the introduction of four-legged animals, mainly deer and pigs (Salas & Tolentino, 2013). Then, the Americans began training women to work jobs away from traditional household roles and responsibilities (Fury Cruz, 2014). The post-World War II era led to urbanization and a Chamorro diet that embraced the dietary components of its colonial influences. This era beckoned in sedentary jobs, cash economy, expansion of military facilities, and heavy usage of supermarket and processed foods such as canned goods and meat (Del Valle, 1978; Pollock, 1986). Canned and imported foods became valuable sources for food security when natural disasters, like Super Typhoons Paka and Pongsona, swept through the island, leaving a barren skeleton behind. Natural disaster preparedness protocols have led to an ample supply of non-perishable foods such as canned SPAM® Family of Products (Austin, MN), corned beef, packaged ramen soup, and canned fruit-

flavored drinks (RS Pobocik, Trager, & Monson, 2008).

Today, many Chamorros identify with canned meats like Spam® as part of the culture and diet, and they are not consuming the variety of plant-based traditional foods from their indigenous ancestors (Pobocik et al., 2008). The fiesta menu, a symbol of Chamorro food culture today, consists of a combination of imported ingredients, native crops, and animal products. The nutrition transition has resulted in various cuisines being shared among different ethnicities, not just Chamorros.

### **The Nutrient Profile on Guam**

The nutrient profile of Guam adults is limited to a few studies. The first study, a cross-sectional study of 24-hour recalls from 400 adults, found the Guamanian diet to be predominantly comprised of grains, meats, and beverages rather than of traditional foods (Pobocik, Trager, & Monson, 2008). Another study analyzed the nutrition quality of a Guam fiesta and found that the amount of energy, total fat, and saturated fat available to each person at the one fiesta meal exceeds an entire day's recommended intakes, with the exception of carbohydrates and dietary fiber (YC Paulino et al., 2008).

There are few studies that have examined the dietary profile of children on Guam. One study examined the nutritional status of a representative sample of middle (n=8,266, grade levels 6 to 8) and high school (n=9,494, grade levels 9 to 12) students on Guam in 1999 and found that 75.3% consumed fruits and vegetables less than once a day (LeonGuerrero & Workman, 2002). In addition, data from the Guam Youth Risk Behavior Survey (YRBS) indicated that among high school students (grades 9 to 12) in 2007, only 16.4% ate fruits and vegetables

like green salad, potatoes, and carrots (Lippe et al., 2008). Data are needed that are representative of children on Guam, especially young children ages 2 to 8 years. This is important to inform intervention and policy makers of the need for resource allocation to address COWOB on Guam (Novotny et al., 2013). Further data are also needed to accurately describe the dietary composition of Guam's children and youth. This is important because obesity-related behaviors during childhood may lead to poor health status and NCDs in adulthood (Daniels, 2006).

### **COWOB on Guam**

The few data available regarding COWOB on Guam depict that estimates are higher than the national average of 32% (Ogden et al., 2014). One survey of 7,615 Guam Department of Education school children ages 3 to 8 years documented the prevalence of childhood overweight as 13.4% and 17.9% for obesity (Y. C. Paulino & Department of Education, 2011). Overweight and obesity combined (31.3%) from this survey was close to one-third of children in this age group in Guam. Among boys, 13.5% were overweight and 20.6% were obese, while the prevalence among girls is 13.3% and 15.3%, respectively (Y. C. Paulino & Department of Education, 2011). In a thesis titled, "A Descriptive Study of Body Mass Index and Pedometer-Determined Physical Activity of Guamanian Adolescents", the BMI and physical activity of a small sample of 192 adolescents in grades 6-8 of mixed ethnicities (105 Chamorro, 45 Filipino, and 42 other ethnicities) was examined (Calvo, 2006) and found the COWOB prevalence of these adolescents on Guam at 39%. A meta-analysis of COWOB prevalence in the USAP found that Guam had the highest prevalence of COWOB for ages 3 to 5 years at 39% (Novotny et al., 2014).

These limited data suggests that addressing COWOB is of the utmost importance in Guam.

### HOW TO ADDRESS COWOB

#### **Prevention vs. Treatment**

Prevention is the upstream approach that seeks to address COWOB using 3 general approaches to initiate healthy lifestyles, which are the universal, selective, and targeted approaches. The universal prevention approach is directed at the whole population. The selective prevention approach focuses on sub-groups of a population through screening efforts to identify high risk groups. The targeted prevention aims at individuals who are known to have existing weight-related conditions (WHO & IOTF, 2000). Prevention strategies recognize the continuity of the basic life course from fetus to old age, as well as the continuum of influences that present opportunities to prevent COWOB from increasing overall in a population (WHO & Consultation, 2003).

Conversely, COWOB treatment is a downstream approach that seeks to normalize weight status through behavior modification therapy. These may include dietary changes for the family, increased physical activity, and reduced sedentary time (WHO & IOTF, 2000). Because children are still growing, treatment strategies focus on preventing further weight gain rather than on losing weight.

#### **Frameworks for Prevention**

The heavy burden of COWOB motivates researchers and international organizations to devise prevention strategies that recognize the broader scope of the obesity equation. The Institute of Medicine (IOM) has a Framework for Action model, which illustrates the various

influences and factors that affect the dietary intake, energy expenditure, and weight status of children and youth (Koplan, Liverman, & Kraak, 2005). These are generally categorized as social norms and values, primary and secondary leverage points and behavioral settings, along with genetic, psychosocial, and personal factors, all of which influence the energy balance and weight status of children and youth. Additional frameworks, such as the Analysis Grid for Elements Linked to Obesity (ANGELO) framework for planning, has been used to develop environmental interventions to reduce childhood obesity in the South Pacific Region Obesity Prevention in Communities (OPIC) collaboration (Simmons et al., 2009). The ANGELO framework has been used to inform the Children's Healthy Living Program (CHL) Framework for Community Engagement to develop environmental interventions that address critical upstream determinants of obesity-related behaviors with potential for long-term, sustainable impacts (Fialkowski et al., 2013; Simmons et al., 2009). Ecological approaches such as the IOM framework, the ANGELO & CHL frameworks are multi-level approaches that target the individual, social and built environments, as well as policies to guide prevention of childhood obesity.

### **Nutrition Environment**

Numerous studies support the influential role that the nutrition environment has on dietary intake and weight status of children. The nutrition environment is common to all the frameworks mentioned above and is recognized as a key factor in shaping eating behaviors. Glanz, Sallis, and colleagues divide the nutrition environment into four different groups, which are the community, consumer, organizational, and information environments (Glanz et al.,

2005; Sallis & Glanz, 2006). The community nutrition environment encompasses the number, type, and location and accessibility, or distribution, of food outlets. The consumer environment includes nutritional qualities, price, promotions, placement, choice range, freshness, and nutritional information that are encountered within and around a retail food outlet.

Organizational nutrition environments include homes and institutions like schools, worksites, churches, healthcare facilities that are available to defined groups instead of the general population. Lastly, the information environment looks at the media and advertising of food outlets and products or lack thereof (Glanz et al., 2005). The nutrition environment shapes the eating habits and physical activity of children by either facilitating or constraining, and encouraging or discouraging recommended health behaviors (Sallis & Glanz, 2006). Issues of the built environment include how it affects important lifestyle decisions, if changing the infrastructure would alter decision-making, and if changes affect weight and overall health of populations (Sallis & Glanz, 2006).

Results of studies examining the relationship between the nutrition environment and obesity are presented in Table 1. A cross-sectional study of Canadian students in grades 6-10 found no association between food retailers surrounding schools and overweight (Seliske et al., 2009). However, other studies found that the presence of convenience stores was positively associated with higher BMI (Galvez et al., 2009; Laska, Hearst, Forsyth, Pasch, & Lytle, 2010). Inside the food store, fruit and vegetable shelf space was not significantly associated with BMI, but cumulative shelf space availability of energy-dense snack foods was positively associated with BMI (Rose et al., 2009). Specific to the Pacific Region, the Healthy Foods Hawaii Intervention (HFH) was a 9 to 11 month intervention trial that targeted both children and adult

caregivers. The study promoted increased store stocking of nutritious foods, point-of-purchase promotions, and interactive cooking sessions in the food stores to examine any changes in knowledge or consumption of healthy foods (Gittelsohn et al., 2010). Key findings from the study revealed significant impacts on caregiver knowledge and perception that healthy foods are convenient, as well as increased children's Healthy Eating Index (HEI) scores for servings of grains, total consumption of water, and overall HEI score.

Fruits and vegetables (FV) are regarded as a priority area in the nutrition environment and are one of five categories of target foods most closely related to obesity and NCDs (Glanz et al., 2005). FV are important in the diet due to their nutrient-density profiles. FV are high in essential vitamins, minerals, and water, contain fiber and phytonutrients, but are relatively low in energy (kcal) and low in fat, with a few exceptions (e.g., mature coconut, avocado). A systematic review affirms the association of FV availability with increased consumption (Jago, Baranowski, & Baranowski, 2007). Current nutrition guidelines in the US indicate three reasons that support recommendations to eat more FV: 1) FV are major contributors of a number of nutrients that are under-consumed in the US, including folate, magnesium, potassium, dietary fiber, and vitamins A, C, and K; 2) FV are associated with reduced risk of NCDs; and 3) FV are relatively low in calories when prepared without added fats or sugars to support achievement and maintenance of a healthy weight for adults and children (USDA & USDHHS, 2010). Sources of FV in the diet can be fresh, frozen, canned, dried, or juiced (as 100% juice) (USDA & USDHHS, 2010).

Although there are multiple ways in which to consume FV, the nutrition quality of fresh

versus frozen, canned, or dried FV has been debated. Consumers consider 'fresh' as natural, wholesome, and thus full of nutrients, and meanwhile consider 'processed', even the minor process of 'quick freezing', as substantially nutrient reduced (Favell, 1998). A study in Europe examining the changes in vitamin C content during the storage of fresh versus frozen vegetables for up to 12 months finds the nutrient status of frozen whole green beans and carrots to be similar to the fresh vegetable at harvest, and also finds frozen spinach to be both comparable to the harvested fresh spinach and superior to market fresh produce (Favell, 1998). Another study examining the carotenoid content of fresh, commercially canned and frozen samples of two corn cultivars from the same production field shows that canning does not decrease carotenoid content in corn and that freezing may increase carotenoid content in one out of the two cultivars of corn (Scott & Eldridge, 2005). Although the immediate post-harvest 'garden fresh' produce is still the freshest and best in quality for FV, the frozen and canned counterparts maintain much of their integrity of nutrient composition for purchasing consumers.

## METHODS FOR DIETARY ASSESSMENT

### **Methods for Assessing the Nutrition Environment**

To assess the nutrition environment, tools have been developed to describe and measure food stores, for their food availability, food accessibility, and marketing (Ghirardelli et al., 2011). The Nutrition Environment Measures Study (NEMS) has developed observational measures of nutrition environments for stores (NEMS-S) and restaurants (NEMS-R) to describe and make comparisons between different types of stores, as well as between higher and lower income neighborhoods in the Atlanta, Georgia metropolitan area (Glanz, Sallis, Saelens, &

Frank, 2007). The NEMS-S tool measures availability of 10 indicator food items (e.g., fruits, ground beef); price and quality have high inter-rater and test-retest reliability that can be applied in different multilevel studies (Glanz et al., 2007).

The Bridging the Gap (BTG) program, which is supported by the Robert Wood Johnson Foundation, has made strides in the reduction of youth substance use and abuse and carries its success over to approach adolescent obesity and obesity-related behaviors, as well as focuses on the role of environmental factors in determining obesity-related outcomes (Chaloupka & Johnston, 2007). Through the Youth, Education, and Society (YES) survey, the BTG has been able to collect information about the school food environment that includes availability of healthful and less healthful food and beverage products, breakfast, lunch, and team programs, additional food accessibility, nutrition information for students/parents, and price differences.

Lastly, the *Network for a Healthy California (Network)* developed the *Communities of Excellence in Nutrition, Physical Activity, and Obesity Prevention (CX<sup>3</sup>)* framework of healthy community indicators, which included a CX<sup>3</sup> Food Availability and Marketing Survey to be used as an indicator of the nutrition environment (Ghirardelli, Quinn, & Sugerman, 2011). Survey features included questions to examine exterior and interior marketing conditions, availability, quality and price of fresh FV, and availability of other healthful food to calculate weighted overall scores and sub-scores (e.g., availability and quality of fruit) as an indicator of a quality community food store for consumers (Ghirardelli et al., 2011). The CX<sup>3</sup> Food Availability and Marketing Survey has good inter-rater reliability and food scores that highlight FV accessibility.

### **Methods for Assessing Individual Intake**

There are three classic methods of assessing dietary individual intake, the 24-hour dietary recall, food record, and food frequency questionnaire (FFQ). Each method has its strengths and weaknesses and is chosen in diet and nutrition research based on the target population and study design. The first two, 24-hour recall and food record, measure foods and amounts actually consumed by an individual on one or more days and are ideal for capturing culturally diverse foods and eating habits (Willett, 2013).

The 24-hour recall is an in-depth interview method asking an individual to describe all food and beverages consumed in the last 24 hours. The assessment is typically administered by a trained interviewer who asks specific open-ended questions to solicit details on portion sizes and eating occasions and probes for additional foods and food preparation methods that the study participant might otherwise forget to mention (Willett, 2013). Strengths of the 24-hour recall include a reduced Hawthorne effect (Nasca & Pastides, 2001; D Rose et al., 2013), wherein the study participant is tempted to alter normal eating behavior to satisfy researcher goals or perceived desired behaviors. This method minimizes subject burden since the participant is not tasked to measure or record anything. However, this method of dietary assessment does increase recall bias, as the participant may or may not remember all foods and beverages or portion sizes consumed the previous day (Baxter, Thompson, & Davis, 1997). Likewise, the one day report may or may not adequately represent a typical day's diet. In addition, foods and beverages may be underestimated based on perceptions about those less healthy (Miles & Scaife, 2003). Young children are not developmentally able to do this, and surrogate reporters may not be able to retrospectively obtain this information on young

children either.

Second, the food record is a method that tasks the study participant to record all foods and beverages consumed at the time of consumption for a designated number of days (Willett, 2013). The researcher usually will provide instructions, written examples, measuring tools, and tips about how to record eating occasions and amounts as they occur. With this method, the study participant does not have to remember foods and beverages consumed in the past (i.e., recall bias) and can record the actual amount of food and beverage consumed using standard measuring tools (e.g., cups, spoons). Food records can be reviewed with the participant right after data collection to increase completeness (Willett, 2013). Weaknesses of the food record include a heavier burden on the participant to document all eating occasions as they occur and a possible influence on eating behavior from conscious recording. This method is dependent on the participant's literacy and integrity in providing a complete diet record of actual diet intake. Surrogates can record for those who cannot record for themselves.

Lastly, the FFQ is the method of asking study participants to complete a questionnaire that aims to measure usual dietary intake patterns over a longer period of time (e.g., 1 month, multiple months, or 1 year). The FFQ has two basic components which are the food list (specific or comprehensive) and a frequency response of consumption of food items from preceding months to a year (Willett, 2013). This method can minimize error from day-to-day variability of diet but may produce errors related to estimation. It is a good method for assessing larger populations of people in epidemiologic studies as it is relatively inexpensive and often self-administered with modest burden to study participants (Willett, 2013). However, the foods in

the questionnaire must match those consumed by the population and thus are not available for every population.

### PROBLEM STATEMENT

Previous research of Chamorros and resident populations on Guam hypothesized that the relatively high levels of COWOB on Guam today are complicated by factors such as acculturative changes to diet and lifestyle, internalization of Western ideals, and increased community awareness of health consequences of COWOB (Pinhey, Heathcote, & Rarick, 1994). This study seeks to examine the nutrition environment, which is known to shape behaviors in other communities around the world, in relation to the weight status of Guam's children in selected communities participating in the CHL Program. For this thesis, the focus will be on the behavioral settings, specifically how the food store environment (FSE) influences the weight status of children and youth. Very little is known about how factors of the FSE impact COWOB and dietary intake on Guam (LeonGuerrero & Workman, 2002). It is important to understand the potential links between the current state of the FSE and the dietary intakes and weight status of children on Guam in order to identify potential areas for improvement that are associated with health outcomes in children.

### RESEARCH OBJECTIVES

The primary objective of this study is to test whether availability and access to FV in food stores is associated with early childhood (2 – 8 years) overweight/obesity ( $\geq 85^{\text{th}}$  BMI percentile) prevalence in selected Guam communities. Secondary objectives are to describe the FSE in selected Guam communities and to examine if actual FV intake of young children in selected

Guam communities influences the relationship between the FSE and early childhood (2 – 8 years) overweight/obesity ( $\geq 85^{\text{th}}$  BMI percentile) prevalence.

## **CHAPTER 2: “PARA I FAMAGU’ON-TA”: FRUIT AND VEGETABLE INTAKE, FOOD STORE ENVIRONMENT, AND CHILDHOOD OVERWEIGHT/OBESITY IN THE CHILDREN’S HEALTHY LIVING PROGRAM ON GUAM**

This is a draft of the article that will be submitted to the Journal of Nutrition Education and Behavior (JNEB) and is included here as chapter two.

Matanane, L., Silva, J., Li, F., Nigg C., Leon Guerrero R., Novotny, R., Fialkowski, M.K. (2015). “Para i famagu’on-ta”: fruit and vegetable intake, food store environment, and childhood overweight/obesity in the Children’s Healthy Living Program on Guam. *Journal of Nutrition Education and Behavior*.

### INTRODUCTION

Childhood overweight/obesity (COWOB) is a growing global epidemic affecting most countries with available data (Butland et al., 2007; Kotani et al., 1997; Lobstein et al., 2004; Ogden et al., 2014; Wang & Lobstein, 2006; WHO, 2014). Researchers describe the “built environment” – the neighborhoods, roads, buildings, food sources, and recreational facilities in which people live (Sallis & Glanz, 2006) – to be obesogenic as it promotes obesity through the food and transportation systems, as well through the physical infrastructure (Kitchen et al., 2004; Popkin et al., 2005; B. A. Swinburn et al., 2011; B. Swinburn et al., 1999). Little is known about the nutrition built environment on Guam, but few available data regarding COWOB prevalence depict estimates for ages 3 to 5 years (39%) that exceed (Novotny et al., 2015) the United States (US) national average (23%) for ages 2 to 5 years (Ogden et al., 2014). The COWOB prevalence on Guam is estimated to be the highest in the US Affiliated Pacific – American Samoa, Commonwealth of the Northern Mariana Islands, Guam, Federated States of Micronesia, Republic of Palau, Republic of the Marshall Islands, Hawai’i and Alaska for ages 3 to

5 years (Novotny et al., 2015).

Fruits and vegetables (FV) are regarded as a priority area in the nutrition environment and are one of five categories of target foods most closely related to obesity and non-communicable diseases (NCDs) (Glanz, Sallis, Saelens, & Frank, 2005). Despite recommendations by the 2010 US Dietary Guidelines for Americans (DGA's) to eat more FV (USDA & USDHHS, 2010), a study examining the nutritional status of a representative sample of middle (n=8,266, grade levels 6 to 8) and high school (n=9,494, grade levels 9 to 12) students on Guam in 1999 found that 75.3% reported consuming FV less than once a day (LeonGuerrero & Workman, 2002). Data are needed that are representative of the nutritional status of children on Guam, especially young children ages 2 to 8 years.

Numerous studies examining the role that the nutrition environment has on children's weight status in addition to diet and activity behaviors has produced inconsistent results. A cross-sectional study of Canadian students in grades 6 to 10 found no association between food retailers surrounding schools and childhood overweight (Seliske, Pickett, Boyce, & Janssen, 2009) while other studies found that the presence of convenience stores was positively associated with higher body mass index (BMI) (Galvez et al., 2009; Laska, Hearst, Forsyth, Pasch, & Lytle, 2010). Specific to the Pacific Region, the Healthy Foods Hawaii Intervention (HFH) found that increased store stocking of nutritious foods, point-of-purchase promotions, and interactive cooking sessions, which targeted both children and adult caregivers, increased children's Healthy Eating Index (HEI) scores for servings of grains, total consumption of water, and overall HEI score (Gittelsohn et al., 2010). A systematic review of the literature affirms the

association of FV availability (e.g., in food stores, schools, home) with increased consumption (Jago et al., 2007).

This study was conceptualized according to ecological approaches such as the Institute of Medicine (IOM)'s Framework for Action model (Koplan, Liverman, & Kraak, 2005), the Analysis Grid for Elements Linked to Obesity (ANGELO) (Simmons et al., 2009), and the Children's Healthy Living Program (CHL) Framework for Community Engagement (Fialkowski et al., 2013). These frameworks emphasize examining upstream determinants of obesity-related behaviors. The primary objective of this research is to test whether availability and access to FV in food stores is associated with early childhood (2 – 8 years) overweight/obesity ( $\geq 85^{\text{th}}$  BMI percentile) prevalence. Secondary objectives are to describe the food store environment (FSE) in Guam; and to examine if actual FV intake of young children influences the relationship between the FSE and early childhood overweight/obesity prevalence. The authors hypothesize that FV availability and access in food stores will be negatively associated with early childhood overweight/obesity on Guam and that FV intakes will mediate this relationship.

## METHODS

### **Study Design**

This is a cross-sectional study of community food stores and weight status of children in Guam participating in the CHL Program (Figure 4). CHL is conducting a community randomized trial in the US Affiliated Pacific (USAP) jurisdictions of Alaska, American Samoa, the Commonwealth of the Northern Mariana Islands, Guam, and Hawai'i. The purpose of the CHL

Program is to study and prevent COWOB in children ages 2 to 8 years from the USAP (Wilken et al., 2013).

The current study focuses on the FSE on Guam. The five communities selected to participate in the community randomized trial in Guam were involved in this cross-sectional analysis. Four of the communities were matched to form two matched pairs while the fifth community served as a temporal indicator of COWOB (Wilken et al., 2013). These communities were selected using the 2000 US Census tract data (US Census Bureau, 2000) and the following criteria: population size  $\geq 1,000$ ,  $\geq 25\%$  of the population were of indigenous/native (Chamorro) descent, and  $\geq 10\%$  of the population was 10 years of age or younger. Details about the CHL community randomized trial intervention and community randomization are described elsewhere (Wilken et al., 2013). Data used in this study were collected as a part of the baseline measurements.

### **Participants and Recruitment**

Children ages 2 to 8 years were recruited from Head Start, Elementary Schools, and Community Centers in the five CHL communities in Guam to participating in the CHL Program baseline measurement from October 2012 through September 2013. In order to ensure adequate statistical power of the child participants to serve as representatives of their communities, sample size goals were 180 children per community, with a minimum n of 150 children measured for anthropometry and a minimum n of 100 children with food and activity logs in each community (Wilken et al., 2013). Parents/caregivers of child participants provided informed consent, and child participants provided assent to be measured (Wilken et al., 2013).

Community food stores were identified by field observation using grid-mapped Google Earth (Mountain View, CA) images to guide community boundaries that were obtained from the Government of Guam Department of Land Management. A comprehensive sample of food stores (i.e., supermarket, large grocery, small market, convenience) in the CHL communities was surveyed from October 2012 to February 2013 with the exception of specialty stores (e.g., bakery, liquor store).

The University of Hawai'i (UH) Human Studies Program and the University of Guam Committee on Human Research Subjects approved all study protocols.

### **Instruments and Measures**

**Anthropometry.** Child anthropometry measures of height and weight were measured by trained CHL staff based on standardized procedures, protocols (CDC & National Center for Health Statistics, 2006; Li et al., 2014; Lohman et al., 1988) and measurement tools (i.e., stadiometer and portable scale). Further details regarding the rationale and design of CHL measurement tools have been published elsewhere (Wilken et al., 2013).

**Socio-demographic information.** Data on socio-demographic information were attained through forms completed by a parent/caregiver. These forms asked parents to provide information about his/her educational attainment and participation in federal food assistance programs, such as Supplemental Nutrition Assistance Program (SNAP) and/or Supplemental Assistance for Women Infants and Children (WIC), as well as the child's age, sex, race/ethnicity and sleep duration.

**Dietary intake.** FV and energy intake of child participants were collected using a 2-day Food and Activity Log (FAL), completed by the parent/caregiver. Instructions and training were provided to parents/caregivers with the use of food models, service ware, and utensils. Along with a tool kit of calibrated utensils (i.e., measuring cups and spoons), parents were given the FAL and a Ziploc® (Racine, WI) bag in which to place food wrappers, labels, and packages (Wilken et al., 2013). The FAL was reviewed by a CHL staff person with the parent/caregiver upon collection. Data were entered into the Pacific Tracker 3 (PacTrac3) food composition database and web application developed and maintained by the Nutrition Support Shared Resource at the UH Cancer Center. PacTrac3 originated from the MyPyramid Tracker developed by the US Department of Agriculture's (USDA) Center for Nutrition Policy and Promotion, which was modified to include information on local foods of the Pacific Region (Murphy et al., 2006; Novotny et al., 2013). PacTrac3 was developed and used for this study to obtain total energy as calorie (kcal) intake, cups of fruits (F), and cups of vegetables (V).

**Nutrition environment.** Community food stores were surveyed by CHL staff using the *Communities of Excellence in Nutrition, Physical Activity, and Obesity Prevention (CX<sup>3</sup>)* Food Availability and Marketing Survey and Store Environment Walkability surveys that were validated for reliability as an indicator of the FSE (Ghirardelli, Quinn, & Sugerman, 2011). Availability and access to FV variables were assessed using the CX3 validated scoring system (Ghirardelli, Quinn, & Sugerman, 2011); however, few of the food stores (n = 14, 13%) surveyed were able to meet the standards for FV availability. Considering the dependence of imported foods in the Pacific Region (Snowdon et al., 2013), the standards for FV were adjusted to give credit to moderate variety and mixed quality for a combined FV score of 28, versus the

published standard of 36, which requires an almost perfect score, to explore the research questions (see Appendix).

### **Procedures and Data Analysis**

Body mass index (BMI) z-scores and percentiles were calculated using the 2000 CDC growth charts, which defined children ages 2 to 19 in the  $\geq 85^{\text{th}}$  to  $< 94^{\text{th}}$  percentile (+1 standard deviation (SD) of z-score) for BMI as overweight and  $\geq 95^{\text{th}}$  percentile (+2 SD of z-score) for BMI as obese (CDC, 2013). BMI was analyzed using SAS<sup>®</sup> 9.3 Statistical Software (SAS Institute, Cary, NC) using the CDC growth charts (available at: <http://www.cdc.gov/nccdphp/dnpao/growthcharts/resources/sas.htm>). All variables followed normal distributions with no adjustments needed. BMI was categorized into 2 categories:  $< 85^{\text{th}}$  percentile (combined healthy weight and underweight) and  $\geq 85^{\text{th}}$  percentile (overweight and obese), to create dichotomous variables with the smaller samples. Consolidation of these the BMI categories allowed for more inclusive analysis since fewer participants were classified as underweight, overweight or obese.

FSE data were analyzed at both the community and participant levels as done elsewhere (Glanz, Sallis, Saelens, & Frank, 2005). At the community level, food store data assessed the number, type, and location of food stores in the CHL communities, in addition to the following food store categories based on the CX3 validated scoring system: 1) acceptance of WIC vouchers and SNAP benefits; 2) availability of fresh F; 3) availability of fresh V; 4) food cost of fresh FV; 5) availability of other healthy foods throughout the store; 6) external advertising; 7) internal advertising and checkout item display; 8) availability of nutrition information to promote FV; 9) store exterior walkability (Ghirardelli, Quinn, & Sugerman, 2011). Summed

together these 9 score categories provided a total store score. Food cost averages were obtained from a CHL Food Cost Survey adapted from the Alaska Food Cost Survey conducted in 4 out of the 5 CHL communities (Greenberg, 2015). Average food cost for broccoli was not obtained in the CHL Food Cost Survey but was substituted with green bell pepper, as it was the closest in nutrient content out of all fresh produce cost data available. Mean scores were analyzed by community, as well as by store type using one-way ANOVA tests in IBM® SPSS® Statistics version 22 (Armonk, NY).

At the participant level, food store data were analyzed based on relative access by study participants from their residences. Residential addresses of study participants and food stores were verified in-person using the Garmin Oregon® 600 GPS handheld unit to record waypoint geographic coordinates (i.e., latitude, longitude) uploaded to Garmin BaseCamp Version 4.3.5 (Olathe, KS). Figure 6 shows the mapping of all coordinates, which was done using ArcGIS Version 10.2 (ESRI; Redlands, CA). Additional buffer and point distance analysis toolkits in ArcGIS were used to identify food stores within 1 mile of residential addresses. A previous study examining the influence of the nutrition environment on dietary fat intake in four rural counties in Southwest Georgia surveyed food stores less than 1 and within 1 to 5 miles of participants' homes (Hermstad, Swan, Kegler, Barnette, & Glanz, 2010). Given the geography of the island of Guam (210 square mile area), 1 mile was used to evaluate direct access to food stores at the participant level. Food store scores were analyzed 2 ways. First, scores were averaged for all stores within a 1 mile radius of the residence for each participant. Second, the nearest store scores of each participant were used.

Dietary intakes of cups of F and V, and total calorie intake were averaged between the 2

days. FV intake variables were coded as meeting the recommendations for children or not (USDA & USDHHS, 2010). Likewise, energy was computed according to energy (kcal) needs of children according to age and sex, as above or below the cutoff for moderately active children in the 2010 DGA's (USDA & USDHHS, 2010). Further, FV intake variables were incorporated into the logistic regression models to determine if FV intake mediated (Baron & Kenny, 1986) the relationship between the FSE and weight status of participants.

Bivariate correlation was used to test associations between fresh FV scores (independent variable; mean and nearest scores), dietary intakes (mediator variable; cups of FV and meets FV recommendations), and BMI (dependent variable; z-scores) of child participants. Logistic regression was then used to test associations between dichotomous variables for fresh FV scores (28 or above) and BMI (<85<sup>th</sup> percentile and ≥85<sup>th</sup> percentile) of child participants using IBM® SPSS® Statistics version 22 (Armonk, NY).

## RESULTS

### Univariate Analyses

Figure 5 shows the breakdown of study participants with valid data used to conduct this study. Characteristics of study participants and their parent/caregiver are summarized in Table 2, to include sociodemographic, sleep and weight data. The mean age of study participants is 5 years. The top race/ethnic groups of study participants are: Chamorro (56%), Chuukese (12%), and Filipino (9%). Prevalence of BMI ≥85<sup>th</sup> percentile in this study is 28% (n = 136). There are no significant differences in F, V, or energy intakes between boys and girls. About

1/5<sup>th</sup> of participants met F intake recommendations and about 1/10<sup>th</sup> met V intake recommendations. Nearly half of participants exceeded energy intake recommendations.

**Descriptive food store analyses.** A total of 111 food stores were surveyed in the 5 communities, with the majority being small markets (73%) (Table 3). Community E had the majority of stores (n=56). Supermarkets and large grocery stores were most similar in all store scores, although supermarkets had the highest total store score (75.8 out of 100 possible) (Table 4). Convenience stores scored lowest (12.9 out of 100 possible). Small markets scored significantly lower than supermarkets and large grocery stores in 8 categories (i.e., WIC/SNAP, Fresh F, Fresh V, Fresh FV, FV price, other healthy foods, interior checkout, and total score). Further, convenience stores scored significantly lower than small markets in 7 categories (i.e., WIC/SNAP, Fresh F, Fresh V, Fresh FV, other healthy foods, interior checkout, and total score). Scores for FV price, walkability, and total score were not available for Community E due to missing data. Out of the 111 food stores surveyed, 85 (77%) stores had fresh FV for sale, but only about half of them (n = 43, 39%) met this study's modified cutoff FV score of 28 or higher, for variety and good-quality fresh FV.

### **Bivariate Analyses**

The mean number of food stores within 1 mile of participant residence was 6, while the mean score to assess the availability of FV in variety and quality was 18.2 out of 40 possible points (46%). Few stores (n=6; 5%) fell outside participant buffers of 1 mile. Several participants (n=32, 7%) had no food stores within 1 mile. The mean distance to any food store within 1 mile of a participant's residence was 0.07 miles (about 374 feet) and 0.09 miles (about

472 feet) for children categorized <85<sup>th</sup> BMI percentile and ≥85<sup>th</sup> BMI percentile, respectively. However, the difference did not reach statistical significance ( $p = 0.47$ ). A significant inverse correlation was found between having a small market closest to participant residence and BMI z-score ( $R = -0.112$ ,  $p < 0.05$ ), while a significant positive correlation was found between having a convenience store closest to participant residence and BMI z-score ( $R = 0.092$ ,  $p < 0.05$ ).

### **Multivariate Analyses**

The multivariate logistic regression model testing the relationship between FSE meeting FV standards and a child being ≥85<sup>th</sup> percentile while being adjusted for presence of supermarket/large grocery/small market/convenience store, parent/caregiver education, SNAP and WIC assistance, race/ethnicity, and sleep did not find any significant associations (Table 5). No significant interactions were found during the model-fitting.

**1 mile Distance.** Neither the availability of FV nor the presence of individual store types within participant buffers were associated with an increased likelihood of being ≥85<sup>th</sup> BMI percentile (Table 5).

**Nearest Food Store.** Despite the correlations between the presence of small market or convenience stores nearest to participant residence and BMI z-scores, no significant association was evident in the logistic regression analysis (Table 5).

**Dietary Fruit and Vegetable Intake.** The current FV intake analysis is based on participants ( $n=355$ ) with valid Food and Activity Log data. Given that no association was found between food store FV scores and BMI, further mediation analysis with dietary FV intake was not

warranted.

## DISCUSSION

This study examined the relationship between the built environment, specifically food store access and FV availability, to a child's likelihood for being  $\geq 85^{\text{th}}$  BMI percentile. This is a novel study design in that it examines multiple levels and types of influences on child weight status, including the nutrition community environment (e.g., access and availability of FV in food stores), consumer environment (e.g., availability and price of fresh FV), and dietary intakes (cups of FV and total energy). COWOB prevalence in this study is 29%, slightly lower than previous estimates for Guam school-aged children ages 3 to 5 years (39%) (Novotny et al., 2015), but higher than the US national average (23%) for ages 2 to 5 years (Ogden et al., 2014).

We did not find significant associations with increased risk for being  $\geq 85^{\text{th}}$  BMI percentile. These findings are supported by Seliske et al., who found no association between food retailers surrounding schools within a 1 km and 5 km radius and overweight among students (n=7281), grades 6 – 10 in Canada (Seliske et al., 2009). However, our findings contradict the majority of analogous studies. For example, Galvez et al (Galvez et al., 2009) demonstrated that the presence of convenience stores and fast-food restaurants near a child's home was significantly associated with increased risk for obesity in children ages 6 – 8 years in East Harlem, New York. Similarly, the availability of convenience stores in school zip codes has been associated with higher BMI in 8<sup>th</sup> and 10<sup>th</sup> grade students (Powell, Auld, Chaloupka, O'Malley, & Johnston, 2007). In addition, studies in adults have found obesity prevalence to be lower in areas with supermarkets and higher in areas with grocery stores or fast food restaurants (Morland, Roux, & Wing, 2006).

For FV intake, most study participants did not meet recommendations for FV or energy based on the DGA's, which supports high prevalence of being  $\geq 85^{\text{th}}$  BMI percentile. Michimi and Wimberly found that the odds of adult obesity increased and odds of consuming  $\geq 5$  FV decreased as distance to supermarket increased in metropolitan areas of the contiguous US (Michimi & Wimberly, 2010). Likewise, other studies found that FV availability in food stores and in the home were associated with increased consumption among children and adolescents (Bere & Klepp, 2005; Cullen et al., 2003; Hearn et al., 1998; Neumark-Sztainer et al., 2003). In Hawai'i, a significant association was found in adults with a greater density of total or healthy food outlets with higher mean intakes of FV at 0.5 kilometers (Ollberding et al., 2012).

There are some limitations to this study. First, this study did not examine all food stores on Guam but rather only those within the communities participating in the CHL program. Therefore, participants may have had other food stores within their 1 mile buffer that were located in another community and were not included in this analysis. Data were also not collected from participants to determine where they shop for groceries, so it cannot be assumed that participant families buy food within 1 mile of their homes. In addition, other food outlets (e.g., fast-food, sit down restaurants, specialty shops) were not surveyed and other consumer nutrition variables (e.g., product placement, store area, price comparison) were not evaluated. This could be a potential area to explore in the future as Rose et al. (Donald Rose et al., 2009) found that FV shelf-space was not significantly associated with BMI, but that cumulative shelf-space availability of energy-dense snack foods was positively associated with BMI. Both the CX3 Food Availability and Marketing survey and the CHL Food Cost survey do not capture common produce sold in Guam food stores since these tools were developed based on

the US mainland produce market. A study by Snowdon et al., found approximately 67% of Guam's food supply is imported from the US, Philippines, and Japan (Snowdon et al., 2013). Further, food stores alone in island communities may not adequately represent access and availability to FV, as well as the nutrition environment, by not accounting for locally grown produce acquired through other means (e.g., family farming).

The results of this study were not able to reveal any effect of the FSE food store environment on COWOB prevalence. Still, it is the first of its kind to evaluate the FSE on Guam and to map of food stores on the island. This is also the first study to evaluate dietary intakes of young children ages 2 – 8 years on Guam. To date, there is no surveillance system in place to monitor dietary behaviors of young children on Guam (Novotny et al., 2013). Finally, this study brings attention to the need to examine this relationship in other islands, which are as geographically isolated and remote like Guam and may have even greater difficulties with access to FV in food stores.

### **Conclusions and Implications**

There is still much to be learned about the nutrition environment on Guam, and its influence on dietary behaviors and weight status, before policies and interventions targeting this domain can be effective in promoting and maintaining child health. Future research is needed to explore other aspects of the nutrition environment, in addition to the physical activity environment, and how they impact the lifestyles and weight outcomes of children on Guam.

### **ACKNOWLEDGEMENTS**

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### CHAPTER 3: CONCLUSION

This study examined the nutrition environment on Guam, to evaluate the relationship between access/availability of FV and a child's likelihood for being  $\geq 85^{\text{th}}$  percentile. This is a novel study design in that it is the first to evaluate the food store environment on Guam using ArcGIS mapping of the island, as well as evaluate multiple levels of the food store environment, namely the consumer environment (e.g., availability of fresh FV) and the community environment (e.g., access to FV in food stores). Additionally, this is the first study to evaluate dietary intakes (cups of FV and total energy) of young children ages 2 – 8 years on Guam. To date, there is no surveillance system in place to monitor dietary behaviors of young children on Guam (Novotny et al., 2013).

COWOB prevalence in this study is 28%, slightly lower than previous estimates for Guam school-aged children ages 3 to 5 years (39%) (Novotny et al., 2015), but higher than the national average (23%) for ages 2 to 5 years (Ogden et al., 2014). The multivariate logistic regression model testing the relationship between meets FV standards and a child being  $\geq 85^{\text{th}}$  percentile included presence of supermarket/large grocery/small market/convenience store, education, SNAP and WIC assistance, race/ethnicity, and sleep did not find significant associations with increased risk for COWOB. Using mean scores for stores within the 1 mile buffer of study participants, neither the availability of FV nor the presence of individual store types within participant buffers was associated with an increased likelihood of COWOB (Table 5). As for the nearest store scores, the correlations between the presence of small market or convenience store nearest to participant residence and BMI z-score were not found to be significant in the

logistic regression analyses after adjusting for potential confounding factors (Table 5).

There are some limitations to this study. First, this study did not examine all food stores on Guam but rather only those within the communities participating in the CHL program. Therefore, participants may have had other food stores within their 1 mile buffer that were located in another community and were not included in this analysis. Data was also not collected from participants to determine where they shop for groceries, so it cannot be assumed that participant families buy food within 1 mile of their homes. In addition, other food outlets (e.g., fast-food, sit down restaurants, specialty shops) were not surveyed and other consumer nutrition variables (e.g., product placement, store area, price comparison) were not evaluated. These are areas to explore in the future as Rose et al. (Donald Rose et al., 2009) found that FV shelf-space was not significantly associated with BMI, but that cumulative shelf-space availability of energy-dense snack foods was positively associated with BMI. Finally, both the CX3 Food Availability and Marketing survey and the CHL Food Cost survey did not capture common produce sold in Guam food stores since these tools were developed based on the US mainland produce market.

Given the heavy reliance on imported foods from countries including the US, Philippines, and Japan, survey tools may need to be revised to better capture imported foods on Guam (Snowdon et al., 2013). Further, food stores alone in island communities may not adequately represent access and availability to FV, as well as the nutrition environment, without accounting for locally grown produce acquired through other means (e.g., subsistence). This brings attention to the need to examine this relationship in other islands, which are as geographically isolated and remote like Guam that may have even greater difficulties with access to FV in food

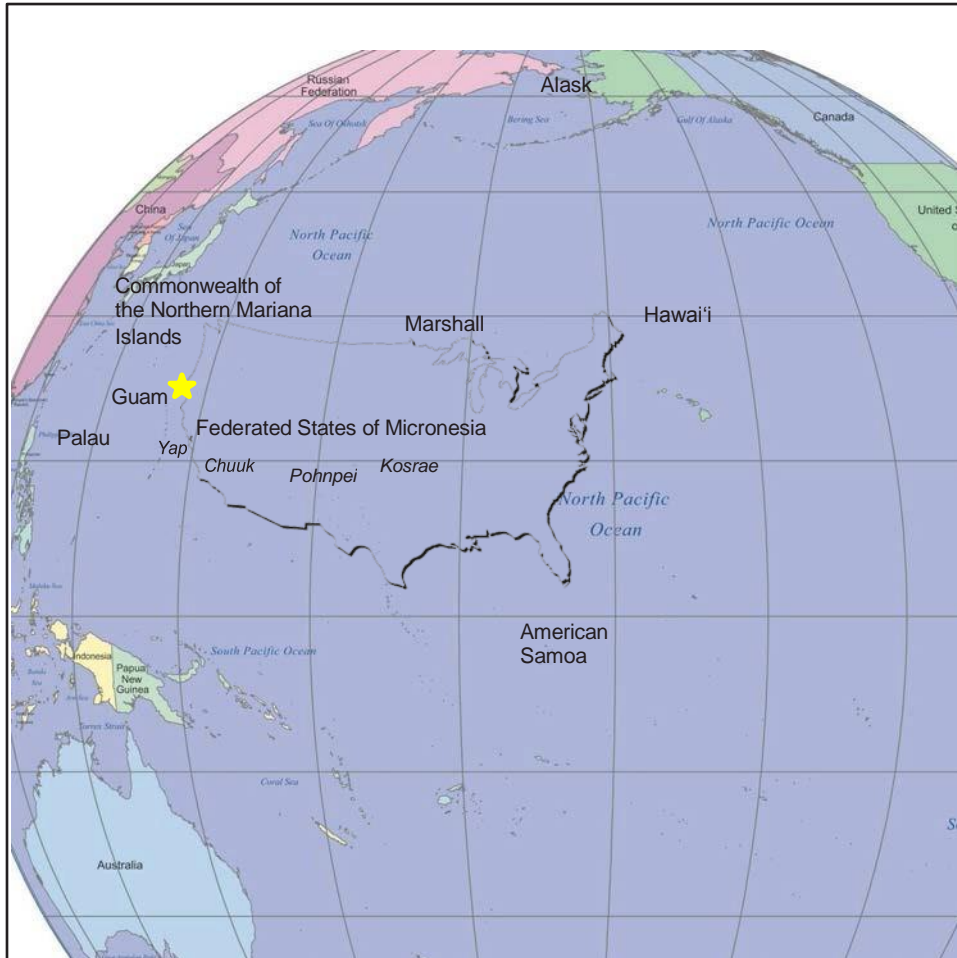
stores.

This study has scratched the surface of the nutrition environment on Guam and its influence on dietary behaviors and weight status. Further work is needed, before policies and interventions targeting this domain can be effective in promoting and maintaining child health. Future research is needed to explore other aspects of the nutrition environment, in addition to the physical activity environment, and how they impact the lifestyles and weight outcomes of children on Guam.

Figure 1. The north and south Pacific that make up Oceania, as well as its sub-regions: Melanesia, Micronesia, and Polynesia. (Picture Source: Holger Behr, Wikimedia Commons)



Figure 2. Map\* of the Pacific Region indicating locations of Hawai'i, the US Affiliated Pacific Islands (American Samoa, Commonwealth of the Northern Mariana Islands, Federated States of Micronesia, Guam, Republic of the Marshall Islands, and the Republic of Palau), Alaska, and the contiguous US. The star indicates the location of the territory of Guam.



\*The overlay of the contiguous US, set between Hawai'i and Guam, indicates that the width of the contiguous US at its widest point, is just 400 miles short of the distance between these two Pacific islands (Bruce Jones Design Inc., 2014; Digital Vector Maps, 2014).

Figure 3. Timeline of Guam Historical Eras

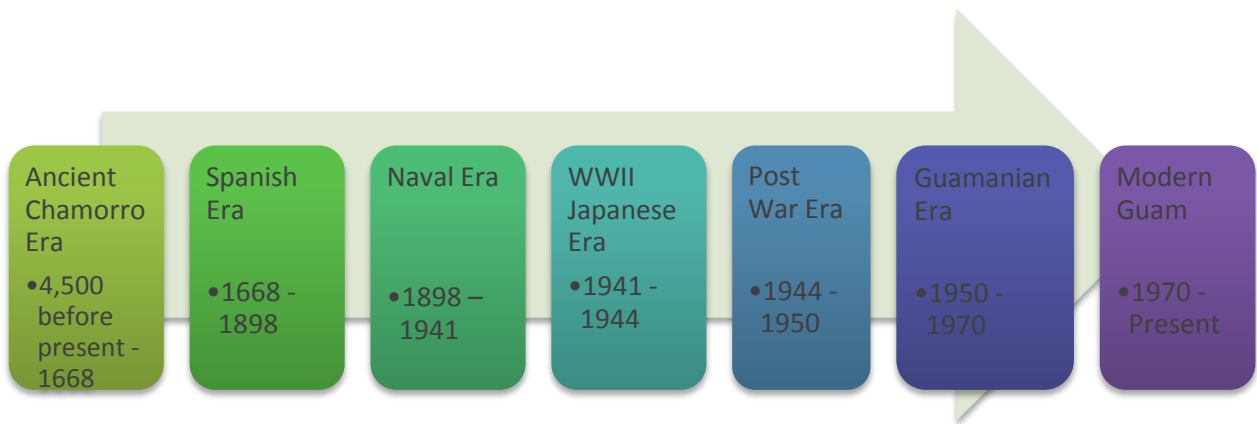
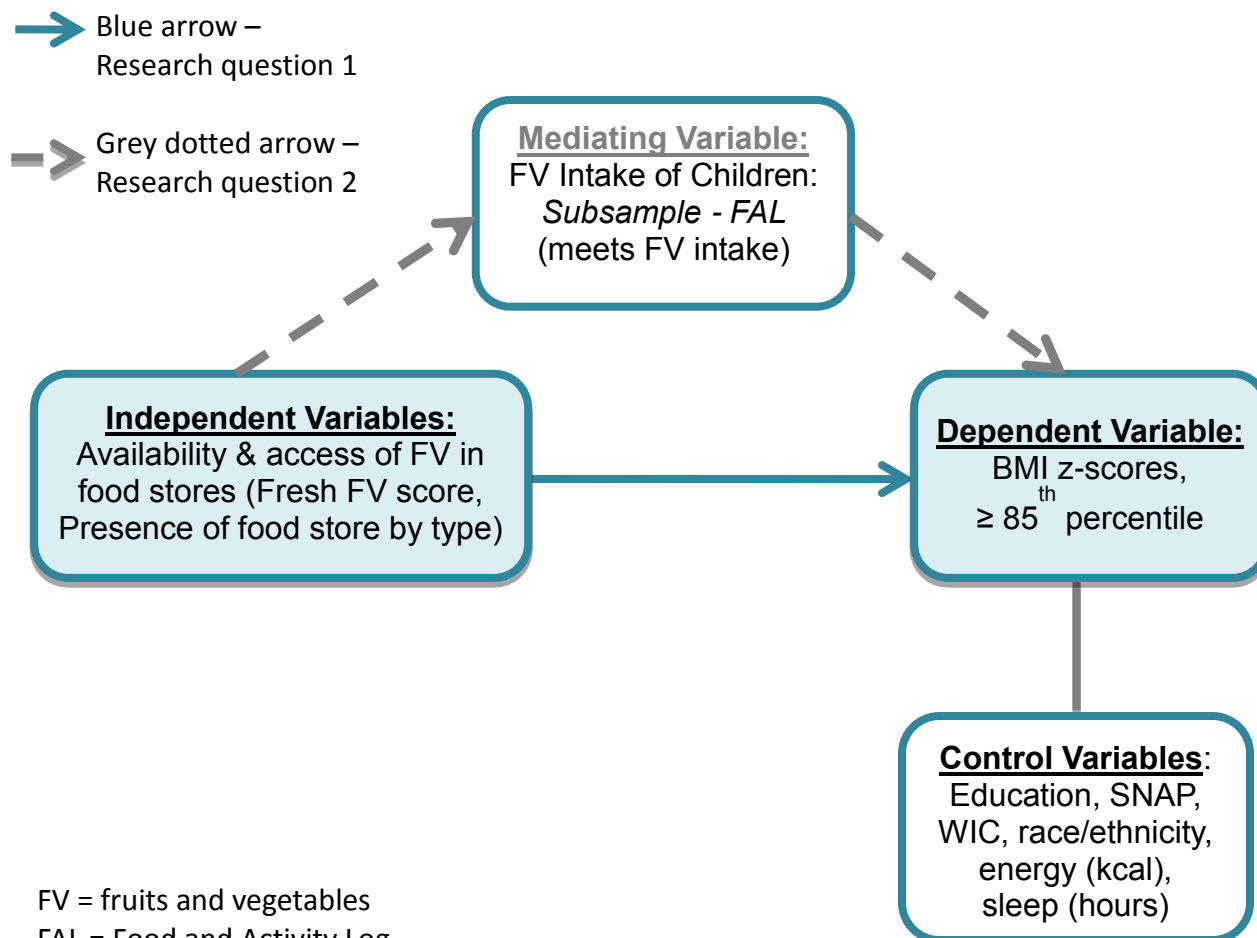


Figure 4. Conceptual framework to examine relationships between the food store environment, fruit and vegetable intake, and prevalence of early childhood (ages 2 to 8 years) overweight/obesity ( $\geq 85^{\text{th}}$  BMI percentile) in selected communities on Guam from baseline measures for the Children's Healthy Living Program



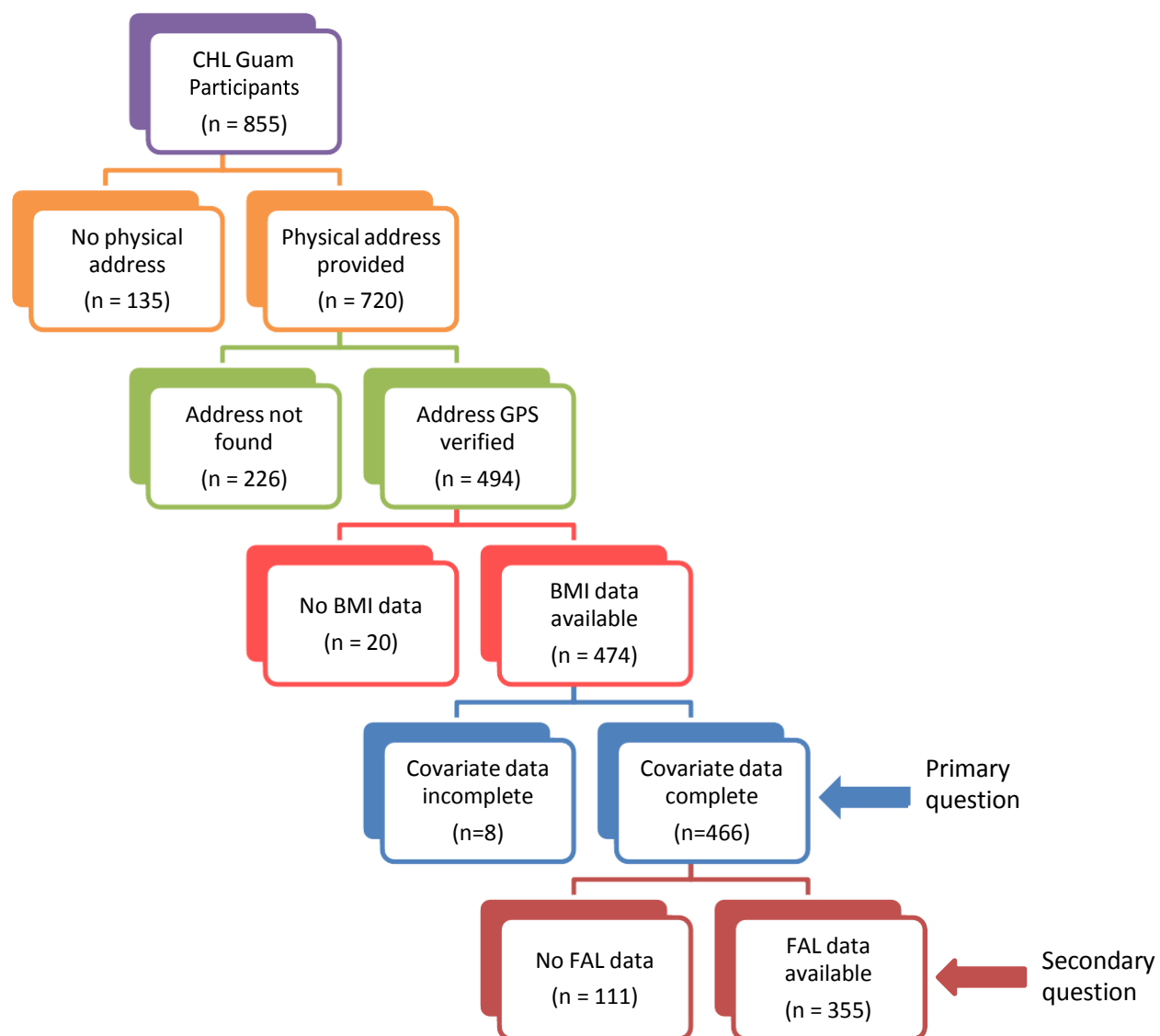
FV = fruits and vegetables

FAL = Food and Activity Log

SNAP = Supplemental Nutrition Assistance Program

WIC = Supplemental Program for Women, Infants, and Children

Figure 5. Process of organizing study participant data from baseline measures for the Children’s Healthy Living (CHL) Program on Guam for primary and secondary analysis in this study



GPS = Global Positioning System; BMI = Body Mass Index; FAL = Food and Activity Log

Figure 6. Map of food stores in relation to participants within a 1 mile buffer (indicated by gray circle) in 1 community participating in the Children's Healthy Living (CHL) Program on Guam.

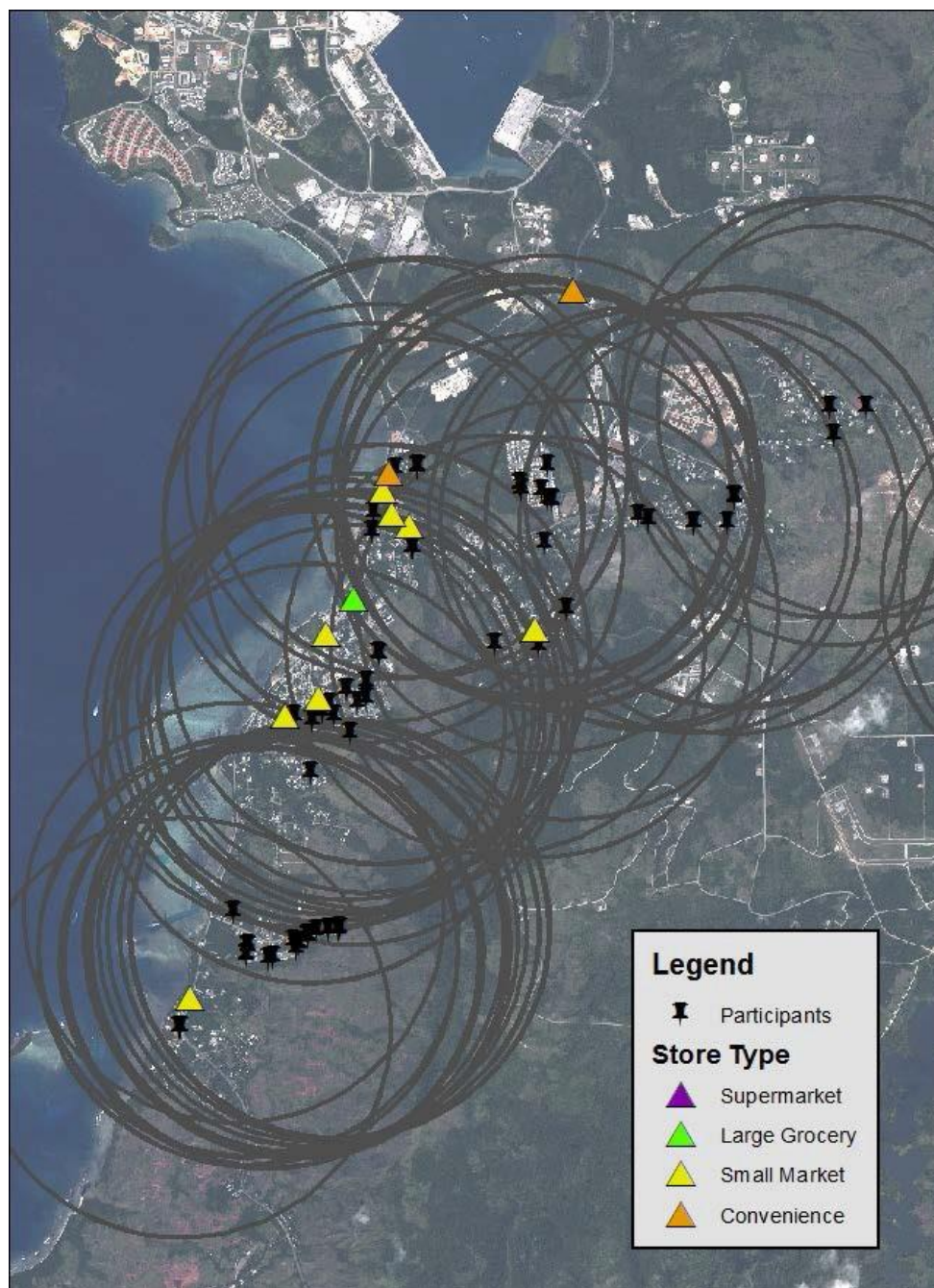


Table 1. Relevant studies examining the relationship between the nutrition environment and overweight/obesity in adults and children

Authors	Study Design	Key Findings
Jago, Baranowski, & Baranowski, 2007	Systematic review of studies that examined associations between FV availability and consumption	FV availability is associated with increased consumption
Seliske, Pickett, Boyce, & Janssen, 2009	Cross-sectional study: students grades 6-10; Health Behavior in School-aged Children survey; internet-based food retailer database; multilevel model	No association between food retailers surrounding schools and overweight among Canadian youth
Galvez et al., 2009	Cross-sectional study: baseline data of 6-8 yr old anthropometry; geocoding of child's home address & store address; walking survey	The presence of convenience stores near a child's residence was associated with a higher BMI-percentile
Morland, Roux, & Wing, 2006	Cross-sectional study: Behavioral Risk Factor Surveillance Survey; census tracts & NAICS <sup>a</sup> geocoding residential & food stores/service establishments; mixed models	Obesity prevalence was lower in areas w/ supermarkets & higher in areas w/ small grocery stores or fast food restaurants.
Rose et al., 2009	Cross-sectional study: urban county census tracts & geocoding; in-store surveys; telephone surveys of residents; multivariable regression	FV shelf-space was not significantly associated w/ BMI; cumulative shelf-space availability of energy-dense snack foods was positively associated w/ BMI
Gittelsohn et al., 2010	Intervention trial: Healthy Foods Hawaii; 9-11 months; target children & adult caregivers; five stores in 2 low-income multi-ethnic communities ; customer & child customer questionnaires, 24h recall; multivariable linear regression	Significant impact on caregiver knowledge & perception that healthy foods are convenient; increased child Healthy Eating Index (HEI) score for servings of grains, total consumption of water, and overall HEI score
Laska et al., 2010	Cross-sectional study: census tracts, GIS <sup>b</sup> & NAICS <sup>a</sup> geocoding; 24h dietary recalls of adolescents & 1 parent; 2-stage adjusted models	BMI z-score & %body fat were positively associated w/ presence of a convenience store; SSB intake was negatively associated w/ distance from home to the nearest restaurant or grocery store
Michimi & Wimberly, 2010	Cross-sectional study: BRFSS telephone survey; census Zip Code Business Patterns & NAICS <sup>a</sup> multilevel logistic regression	Odds of obesity increased & odds of consuming $\geq 5$ FV decreased as distance to supermarket increased in metropolitan areas

<sup>a</sup> NAICS – North American Industry Classification System; <sup>b</sup> GIS – Geographic Information Systems

Table 2. Characteristics of children ages 2 to 8 years in communities (n=5) who participated in baseline measurements for the Children's Healthy Living Program on Guam

	Boys		Girls		All	
<b>TOTAL SAMPLE</b>						
<b>Sex [n (%)]</b>	238	(51%)	228	(49%)	466	(100%)
<b>Age years (mean ± SD)</b>	5.5	± 1.9	5.4	± 1.8	5.4	± 1.8
<b>Education of parent/caregiver [n (%)]</b>						
Less than high school graduate/GED	76	(32%)	73	(32%)	149	(32%)
High school graduate/GED or more	162	(68%)	155	(68%)	317	(68%)
<b>Food Assistance [n (%)]</b>						
SNAP	169	(71%)	164	(72%)	333	(71%)
WIC	75	(32%)	64	(28%)	139	(30%)
<b>Race/ethnicity [n (%)]</b>						
Native Hawaiian/ Pacific Islander (NHPI)	177	(74%)	172	(75%)	349	(75%)
Chamorro	130	(55%)	130	(57%)	260	(56%)
Chuukese	29	(12%)	26	(11%)	55	(12%)
Other NHPI	15	(6%)	15	(7%)	30	(6%)
Asian	24	(10%)	22	(10%)	46	(10%)
Filipino	23	(10%)	21	(9%)	44	(9%)
Other Asian	1	(0%)	1	(0%)	2	(0%)
White	2	(1%)	0	(0%)	2	(0%)
More than one race	35	(15%)	34	(15%)	69	(15%)
<b>Sleep average in 24 hours (mean ± SD)</b>	8.4	± 2.3	8.7	± 2.2	8.5	± 2.3
<b>Sleep categories [n (%)]</b>						
Less than 8 hours	44	(18%)	36	(16%)	80	(17%)
8 hours or more	194	(82%)	192	(85%)	386	(83%)
<b>Weight Status (mean ± SD)</b>						
Body mass index (BMI) z-score	0.4	± 1.2	0.4	± 1.1	0.4	± 1.2
BMI percentile	59.7	± 29.5	61.5	± 29.9	60.6	± 29.7
<b>Weight categories [n (%)]</b>						
Underweight	10	(4%)	7	(3%)	17	(4%)
Healthy weight	167	(70%)	154	(68%)	321	(69%)
Overweight	30	(13%)	43	(19%)	73	(16%)
Obese	34	(14%)	29	(13%)	63	(14%)
<b>FOOD AND ACTIVITY LOG (FAL) SAMPLE</b>						
<b>Sex [n (%)]</b>	177	50%	178	50%	355	100%
<b>Dietary Intake (mean ± SD)</b>						
Fruit cups	0.82	± 0.8	0.87	± 0.9	0.84	± 0.8
Vegetable cups	0.61	± 0.5	0.57	± 0.6	0.59	± 0.5
Calories	1675	± 513	1608	± 593	1641	± 555
<b>Meets Recommendations [n (%)]</b>						
Fruits	37	21%	38	21%	75	21%
Vegetables	20	11%	19	11%	39	11%
Calories	70	40%	94	53%	164	46%

GED = General Education Development; SNAP = Supplemental Nutrition Assistance Program; WIC = Supplemental Program for Women, Infants, and Children

Percentages may not add up to 100% due to rounding; numbers rounded to the nearest tenth of a decimal.

<sup>yz</sup> Mean values within a row with unlike superscript letters were significantly different (P<0.05)

Table 3. Type and characteristics of food stores by community using the CX<sup>3</sup> Food Marketing and Availability Survey in communities (n=5) participating in the Children's Healthy Living Program on Guam

	Max Score	A		B		C		D		E <sup>#</sup>		All	
		n=10		n=10		n = 22		n = 13		n = 56		n = 111	
<b>Store Type</b>		←----- n (%) -----→											
Supermarket		0 (0%)		1 (10%)		1 (5%)		0 (0%)		5 (9%)		7 (6%)	
Large Grocery		1 (10%)		0 (0%)		1 (5%)		1 (8%)		2 (4%)		5 (5%)	
Small Market		7 (70%)		7 (70%)		17 (77%)		10 (77%)		40 (71%)		81 (73%)	
Convenience		2 (20%)		2 (20%)		3 (14%)		2 (15%)		9 (16%)		18 (16%)	
<b>Store Scores</b>		←----- mean ± SD (Minimum / Maximum) -----→											
WIC/SNAP	10	4.6 ± 3.4 <sup>w</sup>	(0/10)	4.9 ± 3.3 <sup>w</sup>	(0/10)	2.9 ± 2.7 <sup>wx</sup>	(0/9)	5.7 ± 2.3 <sup>wy</sup>	(4/10)	3.5 ± 2.2 <sup>wxz</sup>	(0/8)	3.9 ± 2.6	(0/10)
Fresh Fruit (F)	20	3.6 ± 6.7	(0/18)	5.4 ± 7.5	(0/20)	7.5 ± 6.4	(0/18)	9.1 ± 5.6	(0/16)	8.9 ± 7.0	(0/20)	7.9 ± 6.9	(0/20)
Fresh Vegetable (V)	20	8.0 ± 7.5	(0/18)	8.8 ± 6.8	(0/20)	11.0 ± 7.0	(0/18)	12.9 ± 5.5	(0/20)	11.6 ± 7.3	(0/20)	11.0 ± 7.1	(0/20)
Fresh FV	40	11.6 ± 13.3	(0/36)	14.2 ± 13.5	(0/40)	18.5 ± 12.7	(0/36)	22.0 ± 9.7	(0/36)	20.5 ± 13.8	(0/40)	18.9 ± 13.2	(0/40)
FV Price	10	1.2 ± 2.4	(0/7)	1.1 ± 3.1	(0/10)	1.1 ± 2.4	(0/10)	1.3 ± 2.6	(0/7)	--		1.2 ± 2.5	(0/10)
Other Healthy Foods	10	5.8 ± 3.1	(1/10)	6.4 ± 3.3	(0/10)	6.0 ± 3.4	(0/10)	8.2 ± 1.5	(4/10)	6.1 ± 3.2	(0/10)	6.3 ± 3.1	(0/10)
Nutrition Information	4	0.0 ± 0.0	(0/0)	0.0 ± 0.0	(0/0)	0.0 ± 0.0	(0/0)	0.0 ± 0.0	(0/0)	0.1 ± 0.2	(0/1)	0.0 ± 0.2	(0/1)
Exterior Advertising	8	0.6 ± 0.6	(0/2)	0.7 ± 0.9	(0/3)	0.7 ± 1.0	(0/4)	0.4 ± 0.4	(0/1)	1.1 ± 1.0	(0/4)	0.8 ± 0.9	(0/4)
Interior Checkout	8	3.1 ± 0.7	(2/4)	3.3 ± 0.5	(3/4)	3.1 ± 1.0	(0/4)	3.2 ± 0.7	(2/4)	3.3 ± 0.8	(1/5)	3.2 ± 0.8	(0/5)
Walkability	10	5.3 ± 1.9 <sup>w</sup>	(1/6)	7.3 ± 2.7 <sup>wx</sup>	(3/10)	3.0 ± 1.5 <sup>y</sup>	(2/8)	7.2 ± 1.2 <sup>wz</sup>	(4/9)	--		5.2 ± 2.6	(1/10)
TOTAL Score	100	32.2 ± 21.6	(8.5/72)	37.9 ± 23.0	(6/86)	35.3 ± 19.7	(5/70)	48.1 ± 14.2	(17.5/71)	--		38.2 ± 19.9	(5/86)

CX<sup>3</sup> = Communities of Excellence in Nutrition, Physical Activity, and Obesity Prevention; WIC= Supplemental Program for Women, Infants, and Children; SNAP= Supplemental Nutrition Assistance Program

<sup>wxyz</sup> Mean values within a row with unlike superscript letters were significantly different (P<0.05)

<sup>#</sup> Scores for FV price, Walkability, and Total Score are not available for Community E (for these scores total n=55; Supermarket n=2; Large Grocery n=3; Small Market n=41; Convenience n=9)

Percentages may not add up to 100% due to rounding; numbers rounded to the nearest tenth of a decimal

Table 4. Characteristics of stores by store type using the CX3 Food Marketing and Availability Survey in communities (n=5) participating in the Children's Healthy Living Program on Guam

	Max Score	Supermarket		Large Grocery		Small Market		Convenience		Total	
		n = 7		n = 5		n = 81		n = 18		n = 111	
<b>Store Scores</b>		←----- mean ± SD (Minimum / Maximum)-----→									
WIC/SNAP	10	7.3 ± 2.4 <sup>w</sup>	(4/10)	4.6 ± 3.6 <sup>wx</sup>	(0/10)	4.2 ± 2.1 <sup>xy</sup>	(0/10)	0.7 ± 1.7 <sup>z</sup>	(0/5)	3.9 ± 2.6	(0/10)
Fresh Fruit (F)	20	18.3 ± 2.1 <sup>w</sup>	(14/20)	17.6 ± 0.9 <sup>wx</sup>	(16/18)	8.0 ± 6.0 <sup>y</sup>	(0/20)	0.6 ± 2.4 <sup>z</sup>	(0/10)	7.9 ± 6.9	(0/20)
Fresh Vegetable (V)	20	18.9 ± 1.1 <sup>w</sup>	(18/20)	18.4 ± 0.9 <sup>wx</sup>	(18/20)	12.1 ± 5.8 <sup>xy</sup>	(0/20)	1.1 ± 3.2 <sup>z</sup>	(0/10)	11.0 ± 7.6	(0/20)
Fresh FV	40	37.1 ± 3.0 <sup>w</sup>	(32/40)	36.0 ± 0.0 <sup>wx</sup>	(36/36)	20.1 ± 10.9 <sup>y</sup>	(0/40)	1.7 ± 5.1 <sup>z</sup>	(0/20)	18.9 ± 13.2	(0/40)
FV Price	10	7.5 ± 3.5 <sup>w</sup>	(5/10)	6.0 ± 4.6 <sup>wx</sup>	(1/10)	0.8 ± 1.7 <sup>y</sup>	(0/7)	0.0 ± 0.0 <sup>y</sup>	(0/0)	1.2 ± 2.5	(0/10)
Other Healthy Foods	10	9.7 ± 0.8 <sup>w</sup>	(10/10)	9.8 ± 0.4 <sup>wx</sup>	(9/10)	6.8 ± 2.4 <sup>y</sup>	(0/10)	1.9 ± 2.0 <sup>z</sup>	(0/8)	6.3 ± 3.1	(0/10)
Nutrition Information	4	0.1 ± 0.4	(0/0)	0.0 ± 0.0	(0/0)	0.2 ± 0.0	(0/0)	0.0 ± 0.0	(0/0)	0.0 ± 0.2	(0/1)
Exterior Advertising	8	1.4 ± 0.9	(0.5/3)	1.4 ± 1.7	(0/4)	0.7 ± 0.8	(0/2)	1.1 ± 1.2	(0/0.5)	0.8 ± 0.9	(0/4)
Interior Checkout	8	3.3 ± 0.8 <sup>w</sup>	(3/4)	2.6 ± 0.5 <sup>w</sup>	(2/3)	3.4 ± 0.7 <sup>wy</sup>	(0/4)	2.7 ± 0.8 <sup>wz</sup>	(2/4)	3.2 ± 0.8	(0/5)
Walkability	10	5.5 ± 4.9	(2/9)	5.0 ± 3.0	(2/8)	5.4 ± 2.6	(1/10)	4.2 ± 1.9	(1/7)	5.2 ± 2.6	(1/10)
<b>TOTAL Score</b>	<b>100</b>	<b>75.8 ± 14.5<sup>w</sup></b>	<b>(65.5/86)</b>	<b>67.3 ± 6.4<sup>wx</sup></b>	<b>(60/70)</b>	<b>39.8 ± 14.7<sup>y</sup></b>	<b>(5/71)</b>	<b>12.9 ± 12.3<sup>z</sup></b>	<b>(5.5/44.5)</b>	<b>38.2 ± 19.9</b>	<b>(5/86)</b>

CX<sup>3</sup>= Communities of Excellence in Nutrition, Physical Activity, and Obesity Prevention; WIC= Supplemental Program for Women, Infants, and Children; SNAP= Supplemental Nutrition Assistance Program

<sup>wxyz</sup> Mean values within a row with unlike superscript letters were significantly different (P<0.05)

#Scores for FV price, Walkability and Total Score are not available for Community E (for these scores total n=55; Supermarket n=2; Large Grocery n=3; Small Market n=41; Convenience n=9)

Table 5. Bivariate logistic regression examining the associations between access to food stores, availability of fruits and vegetables and childhood overweight/obesity in communities (n=5) participating in the Children's Healthy Living Program on Guam

	Block 1			Block 2		
Mean Scores	Sig.	OR	95% CI	Sig.	OR	95% CI
High school/GED	.231	1.32	.84-2.1	.300	1.28	.80-2.0
SNAP	.803	0.94	.59-1.5	.752	0.93	.58-1.5
WIC	.228	0.75	.47-1.2	.346	0.79	.49-1.3
Race/ethnicity is NHPI	.809	1.06	.66-1.7	.617	1.13	.70-1.8
≥ 8 hours sleep	.728	1.10	.64-1.9	.703	1.12	.64-2.0
> 6 stores <sup>b</sup>				.306	1.48	.70-3.2
Meets FV Score				.324	1.35	.74-2.5
Supermarket <sup>a</sup>				.394	0.78	.44-1.4
Large Grocery <sup>a</sup>				.278	0.59	.23-1.5
Small Market <sup>a</sup>				.569	1.23	.61-2.5
Convenience <sup>a</sup>				.193	0.61	.29-1.3
<b>P</b>				.571		.654
Nearest Store Scores	Sig.	OR	95% CI	Sig.	OR	95% CI
High school/GED	.231	1.32	.84-2.1	.210	1.34	.85-2.1
SNAP	.803	0.94	.59-1.5	.692	0.91	.57-1.5
WIC	.228	0.75	.47-1.2	.314	0.78	.49-1.3
Race/ethnicity is NHPI	.809	1.06	.66-1.7	.696	1.10	.68-1.8
≥ 8 hours sleep	.728	1.10	.64-1.9	.797	1.08	.61-1.9
Meets FV Score				.290	1.32	.79-2.2
Supermarket <sup>a</sup>				.563	0.72	.23-2.2
Large Grocery <sup>a</sup>				.830	0.75	.06-10.0
Small Market <sup>a</sup>				.323	0.67	.30-1.5
Convenience <sup>a</sup>				.986	1.01	.40-2.6
<b>P</b>				.571		.756

GED = General Education Development; SNAP = Supplemental Nutrition Assistance Program; WIC = Supplemental Program for Women, Infants, and Children; NHPI = Native Hawaiian / Pacific Islander

<sup>a</sup> Presence of store type

<sup>b</sup> Greater than the mean number of stores per participant

**APPENDIX**



## B. STORE EXTERIOR

6) Is a school visible from the store (circle one)? **1 - Yes 0 - No**

7) Record information about healthy and unhealthy advertising and products *on all doors and windows of the storefront*. Do not include ads on the sides of the building or on other parts of the property such as the roof, fences or parking lot.

For the following table, only include professionally-produced advertising that depicts brands, logos or products. See definitions to learn what types of items to count.

<i>Tally in grey area, circle totals in white area</i>	# of ADS for Unhealthy	# of ADS for Healthy
<b>a) Small</b> ≤ 1 sheet of 8 1/2" x 11" paper (same size or smaller than this sheet of paper)	0 1-2 3-5 6-9 10 +	0 1-2 3-5 6-9 10 +
<b>b) Medium</b> > 1 up to 10 sheets of paper (bigger than this sheet of paper, but smaller than 10 together)	0 1-2 3-5 6-9 10 +	0 1-2 3-5 6-9 10 +
<b>c) Large</b> > 10 sheets of paper (bigger than 10 of these sheets of paper together)	0 1-2 3-5 6-9 10 +	0 1-2 3-5 6-9 10 +

**Unhealthy foods** are high calorie, low nutrient foods and beverages that include alcoholic beverages, soft drinks and other sweetened beverages including diet drinks, sweet desserts and highly sugared cereals, chips and other salty snacks, most solid fats, fried foods, and other foods with high amounts of sugar, fat and/or sodium.

**Healthy foods** are fruits and vegetables, whole grains, beans, nuts and seeds, non-fat and low fat milk products, and lean meat, poultry, and fish. Healthy foods include minimal or no added fat, sugars, or sweeteners. Unsweetened black coffee is included.

**Do not consider:**  
Cigarettes or tobacco products

Store Exterior Conditions	Circle One
8) Are there any produce bins on the sidewalk in front of the store?	1 - Yes 0 - No
9) Are other products displayed on the sidewalk in front of the store or inside the store <i>next to</i> the window so they are clearly visible from the outside? Please check all that apply: __ soda water other. (specify) _____	1 - Yes 0 - No ← If Yes
10) Are there vending machines on the sidewalk in front of the store? Please check all that apply: __ soda water other. (specify) _____	1 - Yes 0 - No ← If Yes
11) Is there advertising (banners, posters, temporary signs, etc.) on the roof, walls or elsewhere on the property such as on fences, garbage cans or in the parking lot? Please check all that apply: ___healthy___unhealthy	1 - Yes 0 - No ← If Yes
12) Are there any images of <b>healthy</b> food (e.g. tomato, apple) and/or beverages (e.g. milk), painted on doors or windows of the storefront?	1 - Yes 0 - No
13) Are there any images of <b>un-healthy</b> food (e.g. hamburger, hot dog) and/or beverages (e.g., soda, shake) painted on doors or windows of the storefront?	1 - Yes 0 - No
14) Are there any painted murals of <i>healthy</i> food and/or beverages anywhere on the <i>building walls</i> ?	1 - Yes 0 - No
15) Are there permanent bars/chains on the windows or doors? (do not include sliding or rolling chains or bars)	1 - Yes 0 - No
16) If the store sells alcohol, is more than 1/3 of the total window area covered by any type of advertising?	1 - Yes 0 - No 9 - N/A (Store does not sell alcohol)
17) Is "We Accept WIC" signage displayed?	1 - Yes 0 - No
18) Is "We Accept Food Stamps/ EBT" signage displayed?	1 - Yes 0 - No

## C. STORE INTERIOR

19) Number of cash registers throughout store (staffed and unstaffed, for grocery items only) \_\_\_\_\_

### 20) Marketing of foods and beverages next to the main check-out area

Circle "1" for yes if the item or ad is present or "0" for no if the item or ad is not present.

<b>Presence of ads or promotions (fill in BOTH columns):</b>	<b>UNHEALTHY</b>	<b>HEALTHY</b>
Next to check-out ( <u>attached or directly next to</u> )	1 - Yes 0 - No	1 - Yes 0 - No
<u>Below</u> check-out level	1 - Yes 0 - No	1 - Yes 0 - No
On floor (if standing in checkout isle or next to counter)	1 - Yes 0 - No	1 - Yes 0 - No
Hanging from ceiling (directly over register)	1 - Yes 0 - No	1 - Yes 0 - No
<b>Presence of UNHEALTHY products next to or below a check-out counter:</b>		
Gumball or candy machine (next to counter or exit doorway)	1 - Yes 0 - No	
Candy (next to or below counter/check-out)	1 - Yes 0 - No	
Soda (next to or below counter/check-out)	1 - Yes 0 - No	
Chips (next to or below counter/check-out)	1 - Yes 0 - No	
Other:specify (such as cookies, ice cream, beef jerky, energy drinks, etc.)➔	1 - Yes 0 - No	
<b>Presence of HEALTHY products next to or below a check-out counter:</b>		
Granola bars (whole grain, $\geq 2$ g fiber, $\leq 1$ g saturated fat, $\leq 14$ g sugar per serving)		1 - Yes 0 - No
Bagged Nuts/seeds (do not include honey roasted or w/ added sugar) (next to or below counter/check-out)		1 - Yes 0 - No
Fresh fruit (next to or below counter/check-out)		1 - Yes 0 - No
Bottled water (next to or below counter/check-out)		1 - Yes 0 - No
Other:specify (such as dried fruit, trail mix, 100% juice, etc.)➔		1 - Yes 0 - No

21) Are there any health promotion items around the fruit and vegetable display?

1 - Yes 0 - No If no ➔ Go to Question 28a.

22) If there *are* health promotion items around the fruit and vegetable display, circle a number next to the types of health promotion items that are present (more than one can be circled).

- 1 - 5 A Day signs (not on packaging)
- 2 - Nutrition information
- 3 - Fruit and Veggies: More matters
- 4- Children's Healthy living (CHL) or CHL Partnership
- 5 - Other (specify) \_\_\_\_\_

22a) Are there any items promoting locally grown produce? (Circle one) 1 - Yes 0 - No

23) Circle the number that best describes overall availability of fruits and vegetables inside and outside the store.

	<b>None</b>	<b>Limited (1-3 types)</b>	<b>Moderate variety (4-6 types)</b>	<b>Wide variety (7 or more types)</b>
Fresh fruit	1	2	3	4
Fresh vegetables	1	2	3	4

24) Circle the number that best describes the overall quality of the fresh fruit.

0	1	2	3	4
None sold	All or most of fruit is of poor quality (brown, bruised, overripe, wilted)	Mixed quality; more poor than good	Mixed quality; more good than poor	All or most of fruit is of good quality (very fresh, no soft spots, excellent color)

25) Circle the number that best describes the overall quality of the fresh vegetables.

0	1	2	3	4
None sold	All or most of vegetable is of poor quality (brown, bruised, overripe, wilted)	Mixed quality; more poor than good	Mixed quality; more good than poor	All or most of vegetable is of good quality (very fresh, no soft spots, excellent color)

26) Record if the fresh fruit or vegetable is available and the price if possible. If more than one variety of a fruit (e.g. gala or red delicious apples) or vegetable is available, please record the lowest price option. Record the pricing if available (per pound is preferred). If the fruit or vegetable is available by the bag or bunch, record the price only if you can record a weight for the bag (marked on the bottom) or bunch. If a weight is not on the bag or bunch, weigh the item if a scale is present.

	Available? (circle one)	Price posted? (circle one)	Price per			If package/bunch, record weight in pounds and/or ounces
			Pound (preferred if available)	Piece	Package/Bunch (only record if weight is available or can weigh)	
<b>Fruits</b>						
Apples	1 - Yes 0 - No	1 - Yes 0 - No				→
Bananas	1 - Yes 0 - No	1 - Yes 0 - No				→
Oranges	1 - Yes 0 - No	1 - Yes 0 - No				→
<b>Vegetables</b>						
Carrots	1 - Yes 0 - No	1 - Yes 0 - No				→
Tomatoes	1 - Yes 0 - No	1 - Yes 0 - No				→
Broccoli	1 - Yes 0 - No	1 - Yes 0 - No				→
Cabbage	1 - Yes 0 - No	1 - Yes 0 - No				→

## E. OTHER HEALTHY FOODS

27) Record if the following items are available in the store.

Food Item	Circle one
Milk – skim, non fat, plain white ( <u>not</u> flavored- chocolate, strawberry, vanilla)	1 - Yes 0 - No
Milk – 1%, low fat, plain white ( <u>not</u> flavored- chocolate, strawberry, vanilla)	1 - Yes 0 - No
Milk – 2%, reduced fat, plain white ( <u>not</u> flavored- chocolate, strawberry, vanilla)	1 - Yes 0 - No
Mozzarella cheese, part skim	1 - Yes 0 - No
Ground beef or turkey, lean (85% or higher)	1 - Yes 0 - No
Whole chicken	1 - Yes 0 - No
Whole wheat bread	# of ounces on bag _____ 1 - Yes 0 - No ← If Yes
Brown rice	1 - Yes 0 - No
High fiber cereal (≥ 3 grams fiber, ≤ 12 grams sugar per serving)	1 - Yes 0 - No
Oatmeal (plain)	1 - Yes 0 - No
Tortillas, soft corn or whole wheat (no lard)	1 - Yes 0 - No
Soy beverage, plain, with no added sugar or sweeteners	1 - Yes 0 - No
Soy beverage, flavored, vanilla or chocolate	1 - Yes 0 - No
Tofu, plain	1 - Yes 0 - No
Beans, dried	1 - Yes 0 - No
Beans, canned with no added fats, sugar or sweetener	1 - Yes 0 - No
Tuna (light) canned in water	1 - Yes 0 - No
Salmon canned in water	1 - Yes 0 - No
Sardines canned in water, tomato, or mustard	1 - Yes 0 - No
Any canned fruit packed in 100% fruit juice	1 - Yes 0 - No
Any canned vegetable with no added fats, sugar, or sweetener	1 - Yes 0 - No
Any frozen fruit with no added fats, sugar, or sweetener	1 - Yes 0 - No
Any frozen vegetables with no added fats, sugar, or sweetener	1 - Yes 0 - No
Baby food, jarred, single fruit	1 - Yes 0 - No
Baby food, jarred, single vegetable	1 - Yes 0 - No
Baby food, jarred, single meat	1 - Yes 0 - No

**Added sugars or sweeteners include:** Sugar, raw sugar, invert sugar, brown sugar, sucrose, dextrose, fructose, glucose, maltose, high fructose corn syrup, corn sweetener, molasses, syrup, honey, malt syrup, fruit juice concentrates, evaporated cane juice, dehydrated cane juice, brown rice syrup, stevia, sorbitol, mannitol, maltitol, xylitol

28) Fill out the disposition on page 1

**Things to remember:**

**Check for missing data!** Be sure all questions are complete before leaving the store.

## REFERENCES

- Baron, R., & Kenny, D. (1986). The moderator–mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations. *Journal of Personality and Social Psychology*, 51(6), 1173. doi:10.1037/0022-3514.51.6.1173
- Baxter, SD, Thompson, WO, & Davis, HC. (1997). Impact of gender, ethnicity, meal component, and time interval between eating and reporting on accuracy of fourth-graders' self-reports of school lunch. *Journal of the American Dietetic Association*. Retrieved from <http://www.sciencedirect.com/science/article/pii/S000282239700309X>
- Bere, E., & Klepp, K.-I. (2005). Changes in accessibility and preferences predict children's future fruit and vegetable intake. *International Journal of Behavioral Nutrition and Physical Activity*, 2(1), 15. doi:10.1186/1479-5868-2-15
- Berry, J. W. (2003). Conceptual approaches to acculturation (pp. 17–37). Washington, DC: American Psychological Association.
- Bruce Jones Design Inc. (2014). Outline Map. In, [www.bjdesign.com/](http://www.bjdesign.com/): Bruce Jones Design Inc.
- Butland, B, Jebb, S, & Kopelman, P. (2007). Foresight. Tackling obesity: future choices. Project report. ... *choices. Project report*. Retrieved from <http://www.cabdirect.org/abstracts/20073277472.html>
- Calvo, F. D. (2006). *A descriptive study of body mass index and pedometer-determined physical activity of Guamanian adolescents*. University of Hawai'i .
- Cassels, S. (2006). Overweight in the Pacific: links between foreign dependence, global food trade, and obesity in the Federated States of Micronesia. *Globalization and Health*, 2(1),

10. doi:10.1186/1744-8603-2-10

- CDC. (2010). Use of World Health Organization and CDC Growth Charts for children aged 0-59 months in the United States. *MMWR*, 59(No. RR-9).
- CDC. (2013). Use and interpretation of the WHO and the CDC Growth Charts for children from birth to 20 years in the United States.
- CDC, & National Center for Health Statistics. (2006). *Anthropometric procedures*. Hyattsville, MD.
- Central Intelligence Agency. (2014). *The World Factbook, Australia-Oceania: Guam*.
- Chaloupka, F., & Johnston, L. (2007). Bridging the Gap. *American Journal of Preventive Medicine*, 33(4), S147S161. doi:10.1016/j.amepre.2007.07.016
- Chu, M., & Choe, B.-H. (2010). Obesity and metabolic syndrome among children and adolescents in Korea. *Journal of the Korean Medical Association*, 53(2), 142–152.  
Retrieved from <http://synapse.koreamed.org/DOIx.php?id=10.5124/jkma.2010.53.2.142>
- Cole, T., Bellizzi, M., Flegal, K., & Dietz, W. (2000). Establishing a standard definition for child overweight and obesity worldwide: international survey. *BMJ*, 320(7244), 1240.  
doi:10.1136/bmj.320.7244.1240
- Cullen, KW, Baranowski, T, & Owens, E. (2003). Availability, accessibility, and preferences for fruit, 100% fruit juice, and vegetables influence children's dietary behavior. *Health Education & ...* doi:10.1177/1090198103257254
- Cunningham, L. J. (1992). *Ancient Chamorro Society*. The Bess Press.
- Daniels, SR. (2006). The consequences of childhood overweight and obesity. *The future of children*. Retrieved from

<http://muse.jhu.edu/journals/foc/summary/v016/16.1daniels.html>

De Onis, M., Onyango, A. W., Borghi, E., Siyam, A., Nishida, C., & Siekmann, J. (2007).

Development of a WHO growth reference for school-aged children and adolescents.

*Bulletin of the World Health Organization*, 85(9), 660–7. doi:10.2471/BLT.07.043497

Del Valle, T. (1978). *Social and cultural change in the community of Umatac, southern Guam*.

University of Hawaii.

Digital Vector Maps. (2014). Global Map. In, <http://digital-vector-maps.com/>: Digital Vector Maps.

Duncan, JS, & Duncan, EK. (2009). Accuracy of body mass index (BMI) thresholds for predicting

excess body fat in girls from five ethnicities. *Asia Pacific journal of ...* Retrieved from

<http://search.informit.com.au/documentSummary;dn=312872888200591;res=IELHEA>

Encyclopaedia Britannica. (2014). Oceania.

Farooqi, I. (2005). Genetic and hereditary aspects of childhood obesity. *Best Practice &*

*Research Clinical Endocrinology & Metabolism*, 19(3), 359374.

doi:10.1016/j.beem.2005.04.004

Favell, DJ. (1998). A comparison of the vitamin C content of fresh and frozen vegetables. *Food*

*chemistry*. Retrieved from

<http://www.sciencedirect.com/science/article/pii/S0308814697001659>

Fialkowski, M., DeBaryshe, B., Bersamin, A., Nigg, C., Guerrero, R., Rojas, G., ... Novotny, R.

(2013). A Community Engagement Process Identifies Environmental Priorities to Prevent

Early Childhood Obesity: The Children's Healthy Living (CHL) Program for Remote

Underserved Populations in the US Affiliated Pacific Islands, Hawaii and Alaska.

*Maternal and Child Health Journal*. doi:10.1007/s10995-013-1353-3

Freedman, D., & Sherry, B. (2009). The validity of BMI as an indicator of body fatness and risk among children. *Pediatrics*, *124 Suppl 1*, S23–34. doi:10.1542/peds.2008-3586e

Fury Cruz, K. A. (2014). Guam pattered (nurse midwives).

Gable, S., Chang, Y., & Krull, J. (2007). Television Watching and Frequency of Family Meals Are Predictive of Overweight Onset and Persistence in a National Sample of School-Aged Children. *Journal of the American Dietetic Association*, *107*(1), 5361. doi:10.1016/j.jada.2006.10.010

Galvez, M., Hong, L., Choi, E., Liao, L., Godbold, J., & Brenner, B. (2009). Childhood obesity and neighborhood food-store availability in an inner-city community. *Academic pediatrics*, *9*(5), 339–43. doi:10.1016/j.acap.2009.05.003

Ghirardelli, A., Quinn, V., & Sugerman, S. (2011). Reliability of a retail food store survey and development of an accompanying retail scoring system to communicate survey findings and identify vendors for healthful food and marketing initiatives. *Journal of nutrition education and behavior*, *43*(4 Suppl 2), S104–12. doi:10.1016/j.jneb.2011.03.003

Gittelsohn, J., Vijayadeva, V., Davison, N., Ramirez, V., Cheung, L., Murphy, S., & Novotny, R. (2010). A Food Store Intervention Trial Improves Caregiver Psychosocial Factors and Children's Dietary Intake in Hawaii. *Obesity*, *18*(S1), S84–S90. doi:10.1038/oby.2009.436

Glanz, K., Sallis, J. F., Saelens, B. E., & Frank, L. D. (2005). Healthy nutrition environments: concepts and measures. *American journal of health promotion : AJHP*, *19*(5), 330–3, ii.

Glanz, K., Sallis, J., Saelens, B., & Frank, L. (2007). Nutrition Environment Measures Survey in Stores (NEMS-S) Development and Evaluation. *American Journal of Preventive Medicine*,

32(4), 282289. doi:10.1016/j.amepre.2006.12.019

Goran, M. I. (1998). Measurement issues related to studies of childhood obesity: assessment of body composition, body fat distribution, physical activity, and food intake. *Pediatrics*, *101*(3 Pt 2), 505–18.

Goran, M. I., Reynolds, K. D., & Lindquist, C. H. (1999). Role of physical activity in the prevention of obesity in children. *International Journal of Obesity*, *23*(3), S18–S33.

Greenberg, J. (2015). Comparison of food prices in the US Affiliated Pacific Region based on the 2002 USDA Food Security Toolkit and the Thrifty Food Plan. *The FASEB Journal*.

Group. (2006). WHO Child Growth Standards based on length/height, weight and age. *Acta Paediatrica (Oslo)*. Retrieved from <http://www.ncbi.nlm.nih.gov/pubmed/16817681>

Guampedia. (2014a). About Guam/Guahan.

Guampedia. (2014b). Guam's Seven Historical Eras.

Hearn, M., Baranowski, T., Baranowski, J., Doyle, C., Smith, M., Lin, L. S., & Resnicow, K. (1998). Environmental influences on dietary behavior among children: availability and accessibility of fruits and vegetables enable consumption. *Journal of Health Education*, *29*(1), 26–32. doi:10.1080/10556699.1998.10603294

Heerwagen, M., Miller, M., Barbour, L., & Friedman, J. (2010). Maternal obesity and fetal metabolic programming: a fertile epigenetic soil. *American Journal of Physiology - Regulatory, Integrative and Comparative Physiology*, *299*(3), R711–R722.  
doi:10.1152/ajpregu.00310.2010

Hegsted, DM, Darby, WJ, Filer, LJ, & Shank, RE. (1974). COMPARISON OF BODY WEIGHTS AND LENGTHS OR HEIGHTS OF GROUPS OF CHILDREN. *Nutrition Reviews*. doi:10.1111/j.1753-

4887.1974.tb00977.x

Hermstad, A., Swan, D., Kegler, M., Barnette, J., & Glanz, K. (2010). Individual and environmental correlates of dietary fat intake in rural communities: a structural equation model analysis. *Social science & medicine (1982)*, *71*(1), 93–101.  
doi:10.1016/j.socscimed.2010.03.028

Ichiho, HM, Gillan, JW, & Aitaoto, N. (2013). An Assessment of Non-Communicable Diseases, Diabetes, and Related Risk Factors in the Territory of Guam: A Systems Perspective. *Hawai'i Journal of Medicine & ...* Retrieved from  
<http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3689457/>

Jago, R., Baranowski, T., & Baranowski, J. (2007). Fruit and vegetable availability: a micro environmental mediating variable? *Public Health Nutrition*.  
doi:10.1017/S1368980007441441

Karolle, B. G. (2014). Geography of Guam.

Kitchen, P. J., Brignell, J., Li, T., & Jones, G. (2004). The emergence of IMC: a theoretical perspective. *Journal of Advertising Research*, *44*(01), 19–30.  
doi:10.1017/S0021849904040048

Koplan, J, Liverman, CT, & Kraak, VI. (2005). Preventing childhood obesity: health in the balance. Retrieved from  
<http://books.google.com/books?hl=en&lr=&id=2SUDUbGquk4C&oi=fnd&pg=PR1&dq=Solving+the+problem+of+childhood+obesity+within+a+generation:+White+House+Task+Force+on+Childhood+Obesity+Report+to+the+President&ots=MLRLSNXsX-&sig=vLRI5AUXbWOQ7xmQGNvdncwcpdl>

- Kotani, K, Nishida, M, Yamashita, S, Funahashi, T, Fujioka, S, Tokunaga, K, ... Matsuzawa, Y. (1997). Two decades of annual medical examinations in Japanese obese children: do obese children grow into obese adults? *International journal of obesity and related metabolic disorders: journal of the International Association for the Study of Obesity*, 21(10), 912–921. Retrieved from <http://europepmc.org/abstract/MED/9347410>
- Kuczmarski, RJ, Ogden, CL, & Grummer-Strawn, LM. (2000). CDC growth charts: United States. *Advance data*. Retrieved from <http://europepmc.org/abstract/med/11183293>
- Kuczmarski, R. J., Ogden, C. L., Guo, S. S., Grummer-Strawn, L. M., Flegal, K. M., Mei, Z., ... Johnson, C. L. (2002). 2000 CDC Growth Charts for the United States: methods and development. *Vital and health statistics. Series 11, Data from the national health survey*, (246), 1–190.
- Laska, M., Hearst, M., Forsyth, A., Pasch, K., & Lytle, L. (2010). Neighbourhood food environments: are they associated with adolescent dietary intake, food purchases and weight status? doi:10.1017/S1368980010001564
- Latner, J., & Stunkard, A. (2003). Getting Worse: The Stigmatization of Obese Children. *Obesity Research*, 11(3), 452–456. doi:10.1038/oby.2003.61
- Latner, J., Stunkard, A., & Wilson, G. (2005). Stigmatized Students: Age, Sex, and Ethnicity Effects in the Stigmatization of Obesity. *Obesity Research*, 13(7), 1226–1231. doi:10.1038/oby.2005.145
- LeonGuerrero, RT, & Workman, RL. (2002). Physical activity and nutritional status of adolescents on Guam. *Pacific health dialog*. Retrieved from [http://www.researchgate.net/publication/8909282\\_Physical\\_activity\\_and\\_nutritional\\_s](http://www.researchgate.net/publication/8909282_Physical_activity_and_nutritional_s)

tatus\_of\_adolescents\_on\_Guam/file/504635232a5a7a9571.pdf

- Li, F, Wilkens, L, Novotny, R, Fialkowski, M, & Paulino, Y. (2014). Anthropometric standardization in the US Affiliated Pacific: The Children'S Healthy Living Program (1024.6). *The FASEB Journal*. Retrieved from [http://www.fasebj.org/content/28/1\\_Supplement/1024.6.short](http://www.fasebj.org/content/28/1_Supplement/1024.6.short)
- Lippe, J., Brener, N., Kann, L., Kinchen, S., Harris, W. A., McManus, T., & Speicher, N. (2008). *Youth Risk Behavior Surveillance: Pacific Island United States Territories, 2007*.
- Lobstein, T., Baur, L., & Uauy, R. (2004). Obesity in children and young people: a crisis in public health. *Obesity Reviews*, 5(s1), 4–85. doi:10.1111/j.1467-789X.2004.00133.x
- Lohman, T. G., Roche, A. F., & Martorell, R. (1988). *Anthropometric Standardization Reference Manual*. Champaign, IL: Human Kinetics Books.
- Lopez, A., Mathers, C., Ezzati, M., Jamison, D., & Murray, C. (2006). Global and regional burden of disease and risk factors, 2001: systematic analysis of population health data. *The Lancet*, 367(9524). doi:10.1016/S0140-6736(06)68770-9
- Lujan, P. C. (2014). Role of education in the preservation of Guam's indigenous language.
- Marsh, K. G. (2014). Division of labor by age, class, gender.
- Michimi, A, & Wimberly, MC. (2010). Associations of supermarket accessibility with obesity and fruit and vegetable consumption in the conterminous United States. *International journal of health ....* doi:10.1186/1476-072X-9-49
- Miles, S., & Scaife, V. (2003). Optimistic bias and food. *Nutrition Research Reviews*, 16(01), 3–19. doi:10.1079/NRR200249
- Morland, K, Roux, D. A., & Wing, S. (2006). Supermarkets, other food stores, and obesity: the

- atherosclerosis risk in communities study. *American journal of preventive ...* Retrieved from <http://www.sciencedirect.com/science/article/pii/S0749379705004836>
- Moss, A., Klenk, J., Simon, K., Thaiss, H., Reinehr, T., & Wabitsch, M. (2011). Declining prevalence rates for overweight and obesity in German children starting school. *European Journal of Pediatrics, 171*(2), 289–299. doi:10.1007/s00431-011-1531-5
- Murphy, S., Blitz, C., & Novotny, R. (2006). Pacific Tracker (Pac Trac): an interactive dietary assessment program at the CRCH website. *Hawaii Medical Journal, 65*(6), 175–178.
- Must, A., & Parisi, S. (2009). Sedentary behavior and sleep: paradoxical effects in association with childhood obesity. *International Journal of Obesity, S82–S86*. doi:10.1038/ijo.2009.23
- Nader, P., O'Brien, M., Houts, R., Bradley, R., Belsky, J., Crosnoe, R., ... Network, N. (2006). Identifying Risk for Obesity in Early Childhood. *PEDIATRICS, 118*(3), e594–e601. doi:10.1542/peds.2005-2801
- Nasca, P. C., & Pastides, H. (2001). *Fundamentals of Cancer Epidemiology*. Aspen Publishers, Inc.
- Natividad, LL, & Kirk, G. (2010). Fortress Guam: resistance to US military mega-buildup. *The Asia-Pacific Journal*. Retrieved from <http://www2.kobe-u.ac.jp/~alexroni/TR/No.14%20%207.14/JapanFocus.pdf>
- Neumark-Sztainer, D, Wall, M, Perry, C, & Story, M. (2003). Correlates of fruit and vegetable intake among adolescents: Findings from Project EAT. *Preventive medicine*. Retrieved from <http://www.sciencedirect.com/science/article/pii/S0091743503001142>
- Novotny, R., Fialkowski, M. K., Areta, A. A. R., Bersamin, A., Braun, K., Debaryshe, B., ... Wilkens, L. R. (2013). University of Hawai'i Cancer Center Connection: the Pacific way to child

- wellness: the Children's Healthy Living Program for Remote Underserved Minority Populations of the Pacific Region (CHL). *Hawai'i Journal of Medicine & Public Health: a journal of Asia Pacific Medicine & Public Health*, 72(11), 406–8.
- Novotny, R., Fialkowski, M., Li, F., Paulino, Y., Vargo, D., Jim, R., ... Wilkens, L. (2015). Systematic Review of Prevalence of Young Child Overweight and Obesity in the United States-Affiliated Pacific Region Compared With the 48 Contiguous States: The Children's Healthy Living Program. *American journal of public health*, 105(1), e22–e35.  
doi:10.2105/AJPH.2014.302283
- Novotny, R., Fialkowski, M., Li, F., Vargo, D., Paulino, Y., Coleman, P., ... Wilkens, L. (2014). Prevalence of young child overweight and obesity in the U.S-affiliated Pacific region: a meta analysis from the Children's Healthy Living Program (621.6). *TheFASEB Journal*, 28(1).
- Novotny, R., Nigg, C., McGlone, K., Renda, G., Jung, N., Matsunaga, M., & Karanja, N. (2013). Pacific Tracker 2 - expert system (PacTrac2-ES) behavioural assessment and intervention tool for the Pacific Kids DASH for Health (PacDASH) study. *Food chemistry*, 140(3), 471–7. doi:10.1016/j.foodchem.2012.11.047
- Ogden, C. L., Carroll, M. D., Kit, B. K., & Flegal, K. M. (2012). Prevalence of obesity and trends in body mass index among US children and adolescents, 1999-2010. *JAMA*, 307(5), 483–90.  
doi:10.1001/jama.2012.40
- Ogden, C. L., Carroll, M. D., Kit, B. K., & Flegal, K. M. (2014). Prevalence of childhood and adult obesity in the United States, 2011-2012. *JAMA*, 311(8), 806–14.  
doi:10.1001/jama.2014.732

- Ollberding, N. J., Nigg, C. R., Geller, K. S., Horwath, C. C., Motl, R. W., & Dishman, R. K. (2012). Food outlet accessibility and fruit and vegetable consumption. *American journal of health promotion : AJHP*, 26(6), 366–70. doi:10.4278/ajhp.101215-ARB-401
- Organization, W. (1995). Physical status: The use of and interpretation of anthropometry, Report of a WHO Expert Committee. Retrieved from <http://apps.who.int/iris/handle/10665/37003>
- Pacific Islands Health Officers Association, United States Affiliated Pacific Islands. (2010). Board Resolution #48-01: The Burden of Non-Communicable Disease.
- Paulino, YC, Guerrero, R., & Aguon, CM. (2008). Nutritional analysis of a fiesta on Guam. *Micronesica*. Retrieved from <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2743493/>
- Paulino, Y. C., & Department of Education. (2011). *Child body mass index data sy 2010-2011*. Guam: Department of Education, University of Guam.
- Perez, MP. (2002). Pacific identities beyond US racial formations: The case of Chamorro ambivalence and flux. *Social Identities*. doi:10.1080/1350463022000030001
- Perez, M. P. (1993). "Thoughts and confessions of a Chamorro advocate", in Hale'-ta. *Hinasso': Tinige' Put Chamorro, Insights: The Chamorro Identity*. Agana, Guam: Political Status Education Coordinating Committee.
- Pinhey, T. K., Heathcote, G. M., & Rarick, J. (1994). The Influence of Obesity on the Self-Reported Health Status of Chamorros and other Residents of Guam. *Asian American and Pacific Islander journal of health*, 2(3), 195–211.
- Pobocik, RS, Trager, A, & Monson, LM. (2008). Dietary patterns and food choices of a population sample of adults on Guam. *Asia Pacific journal of clinical ...* Retrieved from

<http://apjcn.nhri.org.tw/server/APJCN/17/1/94.pdf>

- Pobocik, R. S., Richer, J. J., & O'Donnell, B. K. (1998). Foods most frequently consumed by fifth grade children on Guam. *Pacific Health Dialog*, 6(1), 57–64.
- Pollock, N. J. (1986). Food habits in Guam over 500 years. *Pacific Viewpoint*, 27, 120–148.
- Popkin, B. M., Duffey, K., & Gordon-Larsen, P. (2005). Environmental influences on food choice, physical activity and energy balance. *Physiology & behavior*, 86(5), 603–13.  
doi:10.1016/j.physbeh.2005.08.051
- Powell, L. M., Auld, M. C., Chaloupka, F. J., O'Malley, P. M., & Johnston, L. D. (2007). Associations between access to food stores and adolescent body mass index. *American journal of preventive medicine*, 33(4 Suppl), S301–7. doi:10.1016/j.amepre.2007.07.007
- Richardson, S. A., Goodman, N., Hastorf, A. H., & Dornbusch, S. M. (1961). Cultural uniformity in reaction to physical disabilities. *American Sociological Review*. 1961, 26(2), 241–247.  
doi:10.2307/2089861
- Rogers, R. R. (1995). *Destiny's Landfall: a History of Guam*. Honolulu: University of Hawai'i Press.
- Rose, D., Hutchinson, P., Bodor, J., Swalm, C., Farley, T., Cohen, D., & Rice, J. (2009). Neighborhood food environments and Body Mass Index: the importance of in-store contents. *American journal of preventive medicine*, 37(3), 214–9.  
doi:10.1016/j.amepre.2009.04.024
- Rose, D., Lockett, B., & Mundorf Rathert, A. (2013). Diet matters: approaches and indicators to assess the role of agriculture in nutrition. Rome.
- Rosner, B., Prineas, R., & Daniels, S. R. (2000). Blood pressure differences between blacks and

- whites in relation to body size among US children and adolescents. *American Journal of ...* Retrieved from <http://aje.oxfordjournals.org/content/151/10/1007.short>
- Saha, C., Eckert, G., Pratt, J., & Shankar, R. (2005). Onset of Overweight during Childhood and Adolescence in Relation to Race and Sex. *Journal of Clinical Endocrinology & Metabolism*, 90(5), 2648–2652. doi:10.1210/jc.2004-2208
- Salas, M. C., & Tolentino, D. (2013). Ancient Chamorro food and diet.
- Sallis, JF, & Glanz, K. (2006). The role of built environments in physical activity, eating, and obesity in childhood. *The future of children*. Retrieved from <http://muse.jhu.edu/journals/foc/summary/v016/16.1sallis.html>
- Scott, C., & Eldridge, A. (2005). Comparison of carotenoid content in fresh, frozen and canned corn. *Journal of Food Composition and Analysis*, 18(6), 551-559. doi:10.1016/j.jfca.2004.04.001
- Secretariat of the Pacific Community. (2010). *NCD statistics for the Pacific Islands Countries and Territories*.
- Seliske, L. M., Pickett, W., Boyce, W. F., & Janssen, I. (2009). Association between the food retail environment surrounding schools and overweight in Canadian youth. *Public health nutrition*, 12(09), 1384–1391. doi:10.1017/S1368980008004084
- Simmons, A., Mavoja, H., Bell, A., Courten, M., Schaaf, D., Schultz, J., & Swinburn, B. (2009). Creating community action plans for obesity prevention using the ANGELO (Analysis Grid for Elements Linked to Obesity) Framework. *Health Promotion International*, 24(4), 311–324. doi:10.1093/heapro/dap029
- Snowdon, W., Raj, A., Reeve, E., Guerrero, R., Fesaitu, J., Cateine, K., & Guignet, C. (2013).

- Processed foods available in the Pacific Islands. *Globalization and Health*, 9(1), 53.  
doi:10.1186/1744-8603-9-53
- Sundblom, E., Petzold, M., Rasmussen, F., Callmer, E., & Lissner, L. (2008). Childhood overweight and obesity prevalences levelling off in Stockholm but socioeconomic differences persist. *International Journal of Obesity*, 32(10), 1525–1530.  
doi:10.1038/ijo.2008.104
- Swinburn, B. A., Sacks, G., Hall, K. D., McPherson, K., Finegood, D. T., Moodie, M. L., & Gortmaker, S. L. (2011). The global obesity pandemic: shaped by global drivers and local environments. *Lancet*, 378(9793), 804–14. doi:10.1016/S0140-6736(11)60813-1
- Swinburn, B., Egger, G., & Raza, F. (1999). Dissecting Obesogenic Environments: The Development and Application of a Framework for Identifying and Prioritizing Environmental Interventions for Obesity. *Preventive Medicine*, 29(6), 563-570.  
doi:10.1006/pmed.1999.0585
- Underwood, R. A. (1990). "The consciousness of Guam and the maladjusted people".
- US Census Bureau. (2000). Census 2000 Gateway.
- US Census Bureau. (2012). *2010 Census of Population and Housing: Guam Demographic Profile Summary File*. Guam State Data Center, Bureau of Statistics and Plans.
- USDA, & USDHHS. (2010). *Dietary Guidelines for Americans, 2010* (7th ed.). Washington, DC: US Government Printing Office.
- Wang, Y., & Lobstein, T. (2006). Worldwide trends in childhood overweight and obesity. *International Journal of Pediatric Obesity*, 1(1), 11–25. doi:10.1080/17477160600586747
- WHO. (2014). Global strategy on diet, physical activity and health: childhood overweight and

obesity.

WHO, & IOTF. (2000). The Asia-Pacific perspective: redefining obesity and its treatment. Health Communications Australia.

Wilken, L., Novotny, R., Fialkowski, M., Boushey, C., Nigg, C., Paulino, Y., ... Deenik, J. (2013).

Children's Healthy Living (CHL) Program for remote underserved minority populations in the Pacific region: rationale and design of a community randomized trial to prevent early childhood obesity. *BMC Public Health*, 13(1), 944. doi:10.1186/1471-2458-13-944

Willett, W. (2013). *Nutritional Epidemiology* (3rd ed., Vol. 40). Oxford University Press.