Dietary Patterns Among East Asian Children Living in the US Affiliated Pacific Region

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DEDICATION

This thesis is dedicated to my mom and dad, Peggy and Garett Mau for supporting me into furthering my education and helping me along this difficult journey. I thank both of them for supporting me financially and the tough love they have given me throughout the years. I would like to thank my mentor and friend, Marie Revilla. To my mentor, Marie Revilla, you have been such a great role model and amazing professor to learn from. Thank you for teaching me to become a better person, always being patient towards me, and most importantly, someone I can look up to. I can always count on you to have my best interests at heart. I wouldn't be the student I am today without you.

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ABSTRACT

Background: Childhood obesity is an increasingly global epidemic that has become a public health concern. The three largest groups of Asian Americans are of East Asian descent (Chinese, Korean, and Japanese) which will be the population of focus in this study. East Asian children may be prone to being overweight or obese due to nutrition transition and acculturation. The 2020-2025 Dietary Guidelines for Americans (DGA) identified that a healthy dietary pattern is higher in fruits, vegetables, whole grains, low- and nonfat dairy seafood, legumes, and nuts. A traditional East Asian dietary pattern includes rice, noodles, seafood or animal protein and vegetables. Limited research suggests that the dietary patterns of Asian American children have changed consuming more refined grains, fast food, sugar sweetened beverages, dairy, and meat. However, there has been less research examining the dietary patterns of East Asian children.

Objective: The purpose of this study was to examine dietary patterns in East Asian children ages 2-8 living in the United States Affiliated Pacific (USAP) Region.

Methods: A secondary analysis was conducted using data from the Children's Healthy Living Program. Reduced rank regression was conducted to determine foods that were being consumed by East Asian children. The food variables that were analyzed included added sugars, cheese, milk, total milk, yogurt, citrus fruits, melons, and berries, other fruits, fruits, non-whole grains, total grain, whole grain, eggs, fish and shellfish, frankfurters, sausage, and luncheon meats, meat, total meat, nuts and seeds, poultry, soybean products, orange vegetables, dark green vegetables, dry beans and peas, other vegetables, white potatoes, other starchy vegetables, tomatoes, total vegetables, and discretionary solid fat weighted for weekday/weekend days. Only factor loadings above |0.2| were considered. Binary logistic regression was used to analyze the relationship

between dietary patterns and overweight/obesity (OWOB) and waist-to-height ratio (WHtR). All models were adjusted for sex and age.

Results: The reduced rank regression did not reveal foods that depict a traditional East Asian diet. Dietary pattern 1 loaded on added sugars, milk products, non-whole refined grains, whole grains, meat, and discretionary solid fat. Dietary pattern 2 loaded positively on added sugars and negatively loaded on milk and milk products, nuts and seeds, and solid fat. Dietary pattern 3 positively loaded on nuts and seeds and negatively loaded on other fruits, total fruits, non-whole refined grain, total grain, whole grain, dark green vegetables, and nuts and seeds. The logistic regression showed no significant association between all three dietary patterns and OWOB. The same was also true when examining the results of the logistic regression between all three dietary patterns and WHtR.

Conclusion: A traditional dietary pattern was not identified in East Asian children living in the USAP. Westernized foods were consumed by East Asian children, which aligns with previous research. Findings indicate that nutrition transition and acculturation may be happening with East Asian children living in the USAP.

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CHAPTER 1: LITERATURE REVIEW

Introduction

There are 18.2 million Asian Americans living in the United States (US) according to the 2017 Census Bureau.[1] Asian Americans accounted for 5.6% of the nation's population in 2017.[1] In 2015, there were 4,948,000 Chinese, 1,411,000 Japanese, and 1,822,000 Koreans living in the US.[1,2]

Childhood obesity has increased globally leading to an epidemic where the prevalence of obesity must be addressed. Preventing and controlling the childhood obesity epidemic has become a public health priority for many countries.[3] The highest childhood obesity rates were observed in the US and Europe.[3]According to the Centers for Disease Control and Prevention (CDC), the prevalence of obesity was 19.3% and affected about 14.4 million children and adolescents in the US from 2017-2018.[4] Obesity has been a growing worldwide problem, but it is particularly a concern for immigrants.[3] Newly immigrated adults from low- and middle- income countries usually exhibit a healthier body weight status than their local counterparts. However, as they live in the host country for 10 years or longer, the risk for developing overweight or obesity can overtake or surpass that for the host population.[3,5] Extensive literature has found that immigrants were more likely to develop overweight or obesity as they become more proficient in the host language and more assimilated into the host culture.[6] There is a growing interest in finding the relationship between acculturation and health status among children of immigrants.[3] A finding of negative acculturation effect has been found, i.e. children's health deteriorates as they are more assimilated to the host culture,[3] nutrition transition can be an important consideration to

addressing obesity. Little research has been done on dietary patterns in Asian American children, particularly East Asian children, to determine their association with overweight and obesity.

Defining East Asia

The East Asian countries include China, Mongolia, North Korea, South Korea, Japan, Hong Kong, Taiwan, and Macau according to the World Atlas.[7] The three largest countries are Japan, China, and Korea[7] and are the focus of this research.

East Asian Migration

In the late 19th century, the first major wave of Asian immigrants came to the US, primarily to Hawai‘i and the West Coast.[8] Migrating to the US, Asians were defined as Asian Americans. Since the Immigration and Nationality Act of 1965, the demographics of Asian Americans have changed rapidly.[8] Over the decades, the modern wave of immigrants were more skilled and educated; in 2010, the second wave of immigrants arrived. In 2014, a total of 42.4 million immigrants migrated to the US. As the immigrant population grew, Asian Americans became the second largest immigrant group.[8] In 2011, 79% of Asian Americans aged 18 years and older were foreign-born.[5] The Asian population in the US increased by 46% between 2000 and 2010 and will double in population size with a projected increase to more than 43 million people by 2050.[8] Most Asians that have migrated to the US are Chinese, Korean, Japanese, Filipino, and Vietnamese.[8]

East Asian Dietary Practices

In East Asian countries, the traditional diet consists of rice, noodles, seafood or animal protein, and vegetables.[9,10,11] In Japan, the term “Washoku” refers to the traditional dietary culture of Japan.[12] “Washoku” is a style of eating in Japan which emphasizes rice, grains, miso soup, dashi

soup (fermented soybeans), fish, seafood, sometimes meats, vegetables, wild plants, mushrooms, seaweed, and shellfish.[12] These foods were categorized as staple food, soup, main dish, and side dishes. Staple food consisted of grains, rice, or noodles. The soup was the miso or dashi soup. Fish, seafood, and sometimes meats were considered the main dish. The side dishes were vegetables, wild plants, mushrooms, seaweed, and shellfish. "Washoku" includes relatively small portion sizes for their main and side dishes which limits overeating compared to American diets which have larger portions that may enhance the consumption of larger meals.[12] The main elements of Washoku that promote positive health outcomes are: (1) the great variety of seasonal foodstuffs, including vegetables and fishes; (2) the primary cooking methods that are based on large amounts of high quality water; (3) the well-balanced nutrition (low-calorie density, low total fat, high quality protein, variety of ingredients, and easy to eat different nutrients); and finally (4) the value of its connection with health and family ties.[12]

In China, two dietary patterns were identified from the China Health and Nutrition Survey. The modern dietary pattern consists of a high intake of fruit, fast food, and processed meat which was positively associated with general/central obesity.[10] The traditional dietary pattern consists of a high intake of rice, pork, and vegetables which was inversely associated with general/central obesity.[10]

In Korea, three dietary patterns were identified by the Department of Food and Nutrition at Kyung Hee University: Korean healthy, animal foods, and sweets.[11] Dietary pattern one (Korean healthy) was identified as high intakes of vegetables, kimchi (spicy raw vegetables), seaweeds, beans, fruits, milk and dairy products.[11] Dietary pattern two (animal foods) was characterized by

high intakes of beef, pork, poultry, and fish as well as fast food including hamburgers and pizzas.[11] Dietary pattern three (sweets) showed high intakes of ice cream, sweet drinks, chocolate, and sweet baked goods, and sugary foods.[11]

United States Dietary Guidelines for Americans

The 2015-2020 US Dietary Guidelines for Americans (DGA) policy report indicates that several nutrients are under-consumed relative to requirement levels set by the Institute of Medicine (IOM).[13] The under-consumed nutrients include vitamin A, vitamin D, vitamin E, vitamin C, folate, calcium, magnesium, fiber, and potassium.[13] For adolescents, premenopausal females, and women who are pregnant, iron is considered an under-consumed nutrient and is a public health concern.

The 2020-2025 DGA identified that a healthy dietary pattern is higher in fruits, vegetables, whole grains, low- and nonfat dairy, seafood, legumes, and nuts; in addition, a low consumption of red/processed meat, sugar sweetened foods and beverages, and refined grains was identified as healthy.[14] The 2020-2025 guidelines encourage the consumption of refined/enriched grains, such as cakes, cookies, pies, breads, rolls, cereals, pastas, and pancakes, in moderation. Children ages 2-4 have received a Healthy Eating Index score of 61 out of 100 which indicates a poor diet.[14] Children ages 5-8 received a score of 55 out of 100.[14] The guidelines state that whole grain consumption is below recommended levels and that intakes of added sugars, saturated fat, and sodium are often consumed above the recommended limits beginning at an early age.[14]

Nutrition Transition

Nutrition transition and migration have been associated with obesity and chronic disease.[15] Nutrition transition refers to the shift from consumption of traditional foods that are rich in fiber and micronutrients, toward consumption of energy-dense foods.[16]

Nutrition Transition in East Asian Countries

Dietary patterns can be efficacious indicators of the impact of diet on health outcomes. One study explored the association between dietary patterns and obesity among older Chinese. Three consecutive 24 hour recalls at the individual level and a food inventory taken at the household level over the same three day period were used.[10] Anthropometric measures were collected by trained staff and other variables such as education level, physical activity level, and marital status were collected as well.[10] Two food patterns were obtained by factor analysis. A traditional dietary pattern loaded heavily on rice, pork and vegetables, and inversely on wheat flour and wheat buns.[10] A modern dietary pattern were characterized by high intake of fruit, dairy, processed food, cakes and fast food, and inversely on rice and wheat flour.[10] For the traditional dietary pattern, there were significant increases in rice, pork, fresh vegetables, fish, poultry and organ meat across quartiles for each sex.[10] Significant decreases were found for corn, wheat flour, and wheat buns. For the modern dietary pattern, there were significant increases in fruit, milk, fast food, eggs, nuts, cakes, dried vegetables, fish, deep-fried wheat, processed meat, wheat buns, and legume products across quartiles for each sex.[10] There were significant decreases for rice and wheat flours compared to the traditional diet in which these two components were high. In addition, this study found that the modern dietary pattern was positively associated with obesity for men and women.[10] However, the traditional dietary pattern was inversely associated with central obesity.[10] The results showed that the traditional dietary pattern was inversely

associated with BMI and waist circumference (WC), while the modern dietary pattern was positively associated with BMI and WC.[10]

Overall, the study concluded that the traditional dietary pattern was inversely associated with the risk of overweight/obesity and central obesity, whilst positively associated with underweight. By contrast, a modern dietary pattern was significantly related to an increased likelihood of having obesity and central obesity, and inversely associated with underweight. Although fruit was documented in the modern dietary pattern, the consumption was below the recommended amount (200-400 g per day).[10] Rice positively loaded in the traditional dietary pattern and has a high glycemic index which was significantly associated with an increased risk of developing type 2 diabetes.[10] In this study, the findings found that a rice-rich traditional dietary pattern was inversely associated with weight gain. Therefore, traditional dietary patterns were associated with lower BMI and WC and modern dietary patterns were associated with higher BMI and WC.

Studies have described the change in dietary practices of East Asian children due to Westernization. For example, in the last 30-plus years, the traditional Japanese diet, which was heavily reliant on rice and other foods such as sweet potatoes, fish, shellfish, and seaweeds, has become somewhat Westernized.[9] Now, meals include more red meats, poultry, milk and other dairy products, eggs, fruit, vegetables, as well as processed food, such as pasta, ham, bacon, catsup and fruit beverages.[9] Rice is still the main staple in Japan but the consumption of rice decreased from 244 pounds per person in 1955 to 154 pounds in 1990 while meat consumption increased rapidly from the 1950's to 1990's from 7.3 pounds to 63.1 pounds per capita per year.[9] A rise in chicken consumption increased by 22.7 pounds per capita followed by pork at 25.4

pounds, beef at 13.4 pounds and other meats at 1.5 pounds.[9] Japanese consumption of milk and dairy products increased six fold from less than 27 pounds per capita to over 183 pounds in the same time frame.[9] Fat and oil consumption increased from 6 to 31.5 pounds as well as starches and flour from 10.1 to 35.3 pounds.[9] Consumption of pulses (mostly soybeans in the form of products, such as tofu and miso, but also peas, lentils, adzuki beans, and others) remained relatively constant at 20.5 pounds per year.[9] Overall, the Japanese diet has transitioned from predominantly rice, fruits and vegetables to more dairy products, meats, grains, fats, and oils.

In Korea, obesity rates have increased; in the 1970's obesity increased from 2 to 3% to 15 to 20% in the 2000's.[11] Dietary patterns have shown associations of child obesity with specific dietary patterns such as sweet foods, meats, low-quality foods, snacks, dairy foods, fruits, and vegetables.[11] Nutrition transition is an ongoing phenomenon in Korea, yet fat intake is still lower and vegetable intake is still higher than children from other Asian countries and most Western countries.[11] The unique aspects of diet transition in Korea may exert an influence to some extent in terms of dietary patterns and their association with obesity in children.[11]

Nutrition Transition in East Asians Living Outside of East Asia

A study of Chinese children ages 0-5 y living in France sought to understand if traditional dietary practices were present in Chinese children living in another country. The aim of this study was to determine if there were cultural and linguistic barriers among Chinese immigrants to the adaptation of Western food resources for preschool children living in France.[17] Dietary practices differed between the French and Chinese children. In France, breast milk is the only recommended food from birth to 5 months of age. From 5 months, fruits, vegetables, meat, fish, and eggs are gradually introduced. At birth, 55% of French newborns were breastfed compared

to 10% of Chinese newborns in France; 20% Chinese women claimed that cow's milk was more nutritious and 55% claimed to be too busy to breastfeed.[17] Chinese children living in France consumed fruit and vegetables for the first time at almost 10 months of age. Meat, fish, and eggs were introduced at 1 year. Chinese children born in France receive only infant formula and rice during the first 10 months of life.

The typical French diets consisted of 4 meals in a 24-hour period while 3 meals were present in the Chinese living in France. Chinese children rarely consumed milk and consumed more fruits while the French hardly consumed fruit but more milk.[17] Overall, Chinese children did not adhere to the French guidelines for infant feeding.

Nutrition Transition in East Asians Living in the United States

Research has shown that compared to their native-born cohorts, newly arrived immigrants have better health, but their health declines the longer they remain in the US and become more acculturated.[18] Acculturation can be defined as the process by which a minority group adopts the cultural lifestyle and behaviors of the host country.[19] Studies show that some immigrants might possess a health advantage due to migration selectivity and a protective native culture; this protective buffer dissipated by the third generation.[20] Antecol (2006) examined the association between length of residency of immigrants and their obesity. The author found that within 10-15 years after immigration, participants in the study had BMIs similar to those born in the US; but the immigrants' BMIs were 2-5% lower than those of US born when they first arrived in the US.[21]

Traditional Asian diets—rice, fruits, and vegetables have been associated with good health outcomes.[22] There are few studies on dietary practices among Asians living outside of Asia, especially in the US Asians who immigrate to the US carry over their dietary practices and preferences but often begin to incorporate westernized foods.[22]

One study revealed an increased consumption of cookies, cakes, and sweet buns for breakfast in children.[22] Another study found salty snacks, desserts, and sugar sweetened beverages were preferred at snack time.[23] One reason for dietary changes is acculturation, the process by which a minority group adopts the cultural lifestyle and behaviors of the host country.[8] Acculturation-related changes in dietary behaviors may play a role for an increased prevalence of obesity, obesity related diseases, and certain cancers observed among Asian immigrants.[22] A literature review of 13 articles on the dietary practices among Asian children living in the US was conducted.[22] Findings from this study found milk to be the most frequently consumed food item among Southeast Asian children.[22] Following milk, the next most consumed items were fruit (more specifically, orange juice), meat, unenriched white rice, and vegetables.[22] Participants reported frequent consumption of breakfast cereals, eggs, bread, cookies, cheese, and noodles.[22] Chinese-American children reported eating approximately seven high-fat and high-sugar items every day and daily consumption of soda and fruit-flavored drinks.[10] The mean energy intake for Asian Americans was reportedly 1,109 kcal per day for 8- to 10-year-olds to 1,494 kcal per day for 4th through 6th graders, with 30-35% of total energy from fat.[22]

When comparing food consumption to other racial groups regarding food consumption, Asian Americans consumed more fruit, more juice, and fewer vegetables than European Americans and

African Americans.[22] Asian Americans reported eating out less often than non-Hispanic whites and Asian American youth reported lower energy intakes and fewer low-fat practices than white children.[22] Even though Asian American children consumed more fruit and ate out less, Asian American children still experienced a change in dietary behaviors.[22]Asian American children preferred Western foods, but diets were characterized by both Asian and American types of food. American foods included desserts, sweetened beverages, bread (e.g. muffin or toast), candy, salty snacks, cereals, and meat (e.g. beef patties or meat sauce).[22] Foods of both cultures included dairy, fruits, and fruit juice.[22]

From the results, a sample of Hmong in California reported eating both Hmong and American foods and a sample of Asians in 12 states reported eating both Asian an American foods.[22] Participants reported consuming foods associated with their cultures such as meat, egg-drop soup or other-typical meals for dinner but for breakfast and lunch, traditional school food were eaten (cereal, hot dogs, pizzas).[22] More research is needed to be done to strengthen this study on dietary practices among Asian American youth.

In the study, *The influence of immigrant generation on obesity among Asian Americans in California from 2013 to 2014***,** the association between immigration generation and obesity among Asian Americans in California was examined.[8] The population-based-sample consisted of Chinese, Filipino, Vietnamese, Korean and Japanese ethnic groups to refine and understand the overall impact of migration on chronic health conditions (obesity).[8] The California Health Interview Survey was a population-based telephone survey designed to produce health data representative of California. A total of 2,967 Asian Americans were included in the sample out

of 40,240 people (Whites [n=25,643], Hispanics [n = 7,996], Blacks [n = 1764]).[8] The study variables included obesity, generational status (first generation, second generation and third generation) and other covariates such as age and race/ethnicity. First generation Asian Americans were defined as those born outside of the US, second generation were defined as those born in the US with at least one foreign-born parent, and all other Asian participants were classified as third-generation or more.[8]

A multiple logistic regression was done to determine the association between immigration generations and obesity among Californian adults.[8] The researchers found, compared to Whites, first generation Asians had lower odds of being obese. Asians were also examined in two groups, Chinese and other Asian groups. Among Chinese, compared to Whites, 1st and 2nd generation Chinese had reduced likelihood of being obese, but such association disappeared for the 3rd generation. Among the other Asian groups, compared to Whites, being of 1st generation was inversely related to obesity, but such association disappeared for the 2nd generation and 3rd generation.[8] An inverse relationship means that as the generation increases, Asian Americans have a higher chance of being obese. Compared to Hispanics and Blacks, Asian (1st generation) had lower odds of being obese. Lastly, 2nd and 3rd generation Asian Americans were associated with higher odds of being obese compared to 1st generation Asian Americans.[8]

Due to acculturation, studies determined if moving to another country is linked to obesity. Increasing rates of obesity are especially associated with diabetes, gallbladder disease, cardiovascular disease, hypertension, sleep apnea, osteoarthritis, and some forms of cancer.[16] Another study, *U.S. acculturation, food intake and obesity among Asian-Pacific hotel workers,*

examined the association between obesity and Asian-Pacific hotel workers.[16] This study focused on examining measures of immigration and acculturation on obesity and risk for chronic disease among Asians and Pacific Islanders living in Hawai‘i. Place of birth, years in the US, generation of migration to the US, language spoken, education, and intake of selected food groups were the variables measured. The study hypothesized that immigration and acculturation were associated with an increased BMI (body mass index) in this population.[16]

The cross-sectional study was done with a sample size of 4530 hotel workers in 30 hotels who were enrolled during the first year of the Work, Weight, and Wellness (3W) program--a group randomized clinical trial aimed to decrease obesity among hotel workers in Hawaii. Height, and weight were measured to calculate BMI; participants filled out an employee questionnaire that included weight loss stage of change, physical activity level, physical activity stage of change, fruit and vegetable stage of change, social support for exercise, decision making style in 3 languages (English, Chinese, or Korean) and what ethnicity they identified with (Asian, Filipino, Pacific Islander, White or Other).[16] Other variables that were collected in the study were immigration variables (generation and immigration status), language, education, acculturation scale, and dietary questions.[16]

The study found that fifty five percent of hotel workers were born outside of the US: 38% in the Philippines, 3% in Japan, 3% in Southeast Asia, 1% in other Pacific Islands and 10% in other locations (eg. China, Korea, Hong Kong).[12] Of the 45% that were born in the US, 35% were born in Hawaii and 10% were born in the US mainland.[16] Fifty-seven percent of the sample was overweight or obese (BMI $\geq$ 25 kg/m^2) while less than 1% were underweight (BMI $\leq$ 18.5).[16]

The BMI of those born in the US was 2.2 kg/m^2 higher than that of those born in another country.[16] A model testing the influence of immigration on BMI showed that, after adjusting for race/ethnicity, those born in the US were 1.3 kg/m^2 heavier than those not born in the US. Females were 2.1 kg/m^{2}lighter than males. Other Asians were 1.1 kg/m^2 smaller than Whites, while Filipinos were 1.3 kg/m^2 heavier, and Pacific Islanders were 3.2 kg/m^2 heavier than Whites.[16] Testing the role of age at arrival in the US ("generation") on BMI, there was a negative linear relationship, with males being larger than females. A regression model from the study showed this relationship, and that the interaction of generation and sex was significant; the effect of generation was dependent on sex, where living in the US had a stronger negative influence on BMI (greater BMI) in males than in females.[16] Examining migration using the variable "acculturation" yielded a similar relationship, where greater acculturation was associated with greater BMI, especially among males.[16] The study found a higher BMI among the more acculturated participants of both sexes, the increase of BMI with acculturation was markedly greater among males.

The Relationship Between Diet and Weight

During 1992 and 2011 in China, the prevalence for overweight increased from 14.6% to 45.4% and obesity tripled from approximately 5.2% to 15.1% in adults aged 18-75 years.[10] Obesity rates have risen due to an increased consumption of more energy-dense, nutrient-poor food with high levels of sugar and saturated fats, combined with reduced physical activity.

China is aging rapidly and it is predicted that 25% of the population will be aged 60 years and over by 2035.[10] By the end of 2012, the population aged 60 years or above accounted for 14.3% of the total population.[10] People aged 80 years and over are increasing more rapidly compared to

60-69 and 70-79.[10] The change in the age structure in China will lead to an increased prevalence of chronic non-communicable diseases (NCDs).[10] NCDs have long duration and progress.[10] The four main types of NCDs are cardiovascular diseases, cancers, chronic respiratory diseases, and diabetes.[10] In addition, nonalcoholic fatty liver diseases (NAFLD) precede the further development of metabolic syndrome and some NCDs, such as type 2 diabetes, especially in the older population.[10] With diet, it can be an important determining factor of having NCDs. China is also facing an obesity epidemic and it can be considered a chronic condition, as well as an important biological risk factor for NCDs.[10]

According to the 2013-2014 National Health and Nutrition Examination Survey (NHANES) the age-adjusted prevalence of obesity in the US was 35% for men and 40.4% for women.[8] Compared to 2001, obesity prevalence in 2011-2012 has increased among Chinese (3.8% versus 6.1%), Japanese (9.0% versus 15.0%), Filipino (8.8% versus 18.7%), Vietnamese (3.4% versus 6.8%), Southeast Asians (5.8% versus 19.7%), and multiple Asian groups (5.8% versus 12.3%).[8] Increases in obesity prevalence were also observed in other ethnic groups as well (e.g., Whites, Blacks).

Body Mass Index (BMI) and Overweight and Obesity (OWOB)

Body mass index (BMI) can be calculated from weight and height as an indicator of adiposity.[24] In the US, the 2000 Centers for Disease Control and Prevention (CDC) growth charts are commonly used as the reference for sex-specific BMI-for-age percentiles for children.[25] These CDC charts for ages 8-19 years were constructed by using data from nationally representative surveys covering the years 1963 through 1980.[25] Obesity can be defined as a body mass index

(BMI) at or above the sex-specific 95th percentile on the CDC BMI-for-age growth charts.[25] These cut offs have been identified as optimal cut off points for determining adiposity.

Waist-to-Height Ratio (WHtR)

Waist-to-height ratio (WhtR) has been recommended as an alternative measurement method for determining obesity/abdominal obesity.[26] It is a simple age-independent marker to prevent the need for age-related reference charts in different ethnic/gender groups.[26] WHtR can be calculated by the waist circumference (WC) divided by height values.[26] Studies have been conducted in determining cut off points for WHtR.

A study conducted between November and December 2011 in Gaziantep Turkey determined possible cut-off points for defining obesity/abdominal obesity.[26] This study focused on children aged 6-17 years. Students completed a questionnaire which was prepared by researcher's based on the review of the previous literature.[26] The results showed the cut-off points for all students, girls, boys, children and adolescents. The cut-off points were 0.4769, 0.4766, 0.4767, 0.4922, and 0.4693 respectively.[26] Therefore, the results indicated that the optimal cut-off values of WHtR for obesity/abdominal obesity were detected at 0.50 in both sexes, children, and adolescents.

Another study was done in Japan that determined the optimal cut-off points for BMI, WC, and WHtR. The target population for this study was fifth-grade school children (age 10 years).[27] The study was conducted between 2008-2010. WHtR was calculated by WC divided by height.[27] The Youden index (J) was used to determine optimal cut-off values of BMI, WC< and WHtR for

identification of excess abdominal fat. Optimal WHtR cut-off values were identified as 0.50 for boys and 0.49 for girls.[27]

Overall, both studies indicated that the optimal cut-off point for WHtR in children is 0.5.[26,27] Studies have stated that this anthropometric measurement is a good predictor of general/central adiposity.[27] Also, WHtR offers advantages of the same boundary values which can be used for both gender/age in different ethnic groups.[27] WHtR was not associated with age, therefore this cut off value can be used for all age groups.[26]

Diet, Weight, and Cultural Food Practices in East Asians

Over time, dairy, sugar, and meat consumption has increased due to the expansion of large-scale agriculture. Due to westernization and acculturation, the East Asian population started consuming more meat, dairy, and sugar where they stopped consuming their typical diet which is rice, vegetables, and lean protein. Westernization may explain why a change in diet happened in an individual's home country. Acculturation can explain why an individual adapts to the host country's culture, diet, and customs. Adapting to another country's culture and diet due to the nature they are presented in. An individual may not necessarily want to be acculturated in their new country but due to food, customs, and lifestyle offered to them, the individual may not realize they are being acculturated. Previous studies have shown that acculturation may be linked to obesity and change in dietary practices.[8] Depending on the generation of the individual (first, second, and third), acculturation can be tied to weight status.[8] The longer an individual is away from their home country, there is a higher chance of being obese.[8]

Culture, Diet, and Other Outcomes

The health of an immigrant population is a function of influences derived from the sending country, the receiving country, and the migration and resettlement experience itself.[8] The existence of a healthy immigrant effect, i.e. that immigrants are on average healthier than the native born, is a widely cited phenomenon across a multitude of literatures including epidemiology and the social sciences.[8] Immigrants to Canada experience lower risk of cardiovascular disease (CVD) compared to long-term residents, indicating a healthy immigrant effect but, this protective effect appeared to erode slightly over time.[8] Previous studies showed the healthy immigrant effect in Chinese immigrants having a lower asthma prevalence, lower body mass index, and overall better general health than native born residence in Canada[8]

Problem Statement

Based on the results of this literature review, the aim of this thesis is to examine the dietary patterns of East Asian children living in the US Affiliated Pacific Region (USAP). Examining dietary patterns in children is important because prevention of obesity should be started early. The aim of this thesis is to determine what dietary patterns East Asian children in the USAP are consuming. This study can serve as an introduction to examining dietary patterns in East Asian children and its possible relationship with OWOB or WHtR in these children (see figure 1 and 2). With previous studies suggesting that dietary patterns have changed among Asian American youth and obesity prevalence increasing, the objectives of this thesis are:

1) To determine what dietary patterns occur in East Asian children 2 - 8 years of age residing in the USAP Region. It is hypothesized that dietary patterns of East Asian children in the USAP Region will display characteristics of a traditional East Asian diet.

2) To determine which dietary patterns contribute to a lower likelihood of being overweight or having obesity in children 2 - 8 years of age residing in the USAP Region. The hypothesis is that East Asian children living in the USAP Region that consume a diet more characteristic of a traditional East Asian diet will have a lower likelihood of having overweight or obesity.

3) To determine which dietary pattern contributes to a waist to height ratio below the cut off of 0.5. The hypothesis that East Asian children living in the USAP Region that consume a diet more characteristic of a traditional East Asian diet will have a lower likelihood to have a waist to height ratio below the cut off of 0.5

Framework

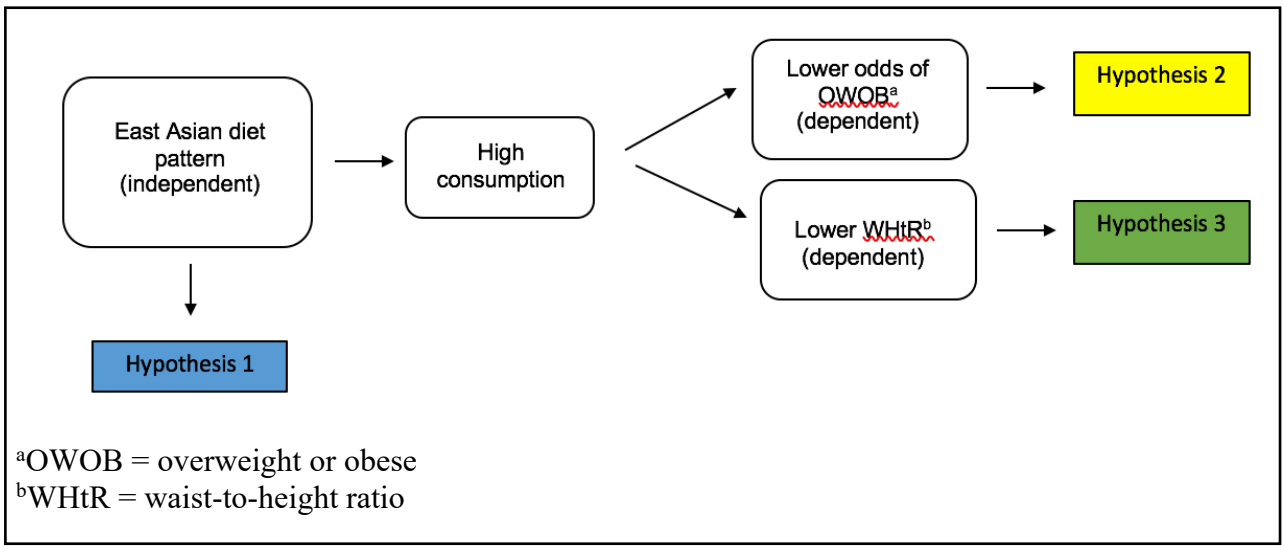
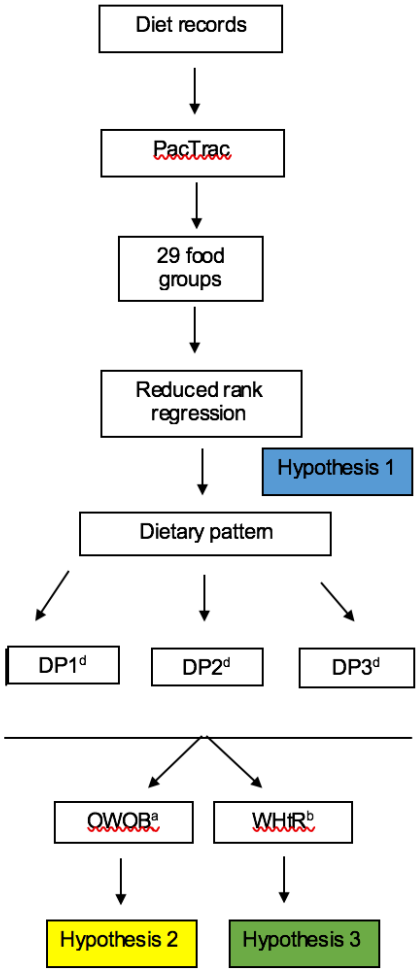


Figure 1: Framework for identifying dietary patterns and OWOB and WHtR in East Asian Children Living in the US Affiliated Pacific Region



[a]OWOB = overweight or obese
[b]WHtR = waist-to-height ratio
[c]PacTrac = Dietary assessment program used to evaluate dietary data for nutrition studies in the Pacific Island
[d]DP = dietary pattern

Figure 2: Analytical framework used to assess hypothesis 1, 2 and 3

CHAPTER 2: DIETARY PRACTICES AMONG EAST ASIAN CHILDREN LIVING IN THE U.S. AFFILIATED PACIFIC REGION

Introduction

Childhood obesity is an ongoing global epidemic and public health concern.[3] The highest rates of childhood obesity occur in the United States (US) and Europe.[3] From 2017-2018, obesity prevalence was at 19.3% which affected about 14.4 million children and adolescents in the US.[4] For children ages 2-5 years old, the prevalence of obesity was 13.4% and 20.3% for 6-11 year-olds.[4] Obesity is also a concern for immigrant populations and ethnic minorities.[3]

Newly immigrated adults exhibit healthier weight status compared to the host population, however, the longer an immigrant lives in the host country, the risk for developing overweight or obesity can overtake or surpass that for the host population.[3] The Asian American population is growing at a rapid rate of 81% between 2000-2019.[28] According to the 2017 Census Bureau, there are 18.2 million Asian Americans living in the US.[28] In 2015, there were 4,948,000 Chinese, 1,411,000 Japanese, 1,822,000 Korean living in the US.[1,2,29] They are the largest groups of Asians living in the US.[28] East Asia can be defined as a region occupied by the easternmost countries of the Asian continent.[7] These countries consist of Japan, North Korea, South Korea, Mainland China, Taiwan, Hong Kong, Mongolia, and Macau.[7] The term "East Asia" can either be geographical or cultural. For this study, the population of focus are children identified as Chinese, Japanese, and Korean.

The prevalence of obesity, overweight, and waist circumference has been increasing in all three East Asian populations. According to the 2013-2014 National Health and Nutrition Examination Survey (NHANES) the prevalence of obesity for adults in the US has increased among Chinese from 3.8% to 6.1%, 9.0% to 15.0% for Japanese, 5.8% to 19.7% for Southeast Asians, and multiple Asian groups from 5.8% to 2.3% from 2011-2012.[8] One potential contributor to the rising obesity rates is nutrition transition and acculturation where individuals start consuming a dietary pattern more similar to a Western dietary pattern which is high in energy and low in nutrient density. Obesity is associated with increased risk for chronic disease.[16] Increasing rates of obesity are especially associated with diabetes, gallbladder disease, cardiovascular disease, hypertension, sleep apnea, osteoarthritis, and some forms of cancer.[16]

Acculturation can be defined as the process by which a minority group adopts the cultural lifestyle and behaviors of the host country.[3] In the late 19th century, many Asian immigrants came to the US.[8] In 2014, a total of 42.4 million immigrants migrated to the US.[8] As individuals started migrating more to the US, individuals started become more acculturated to the lifestyle, culture, and diet of their new home country.

Nutrition transition can be defined as a shift away from the consumption of traditional foods that are rich in fiber and micronutrients, and a shift toward consumption of energy dense foods.[16] In East Asia, dietary practices are different compared to other countries such as the US, with a typical diet consisting of rice, fish, tofu, bean sprouts, cabbage, beef, seafood (shrimp), and eggs.[10–12,22] However, a nutrition transition has been occurring globally. For example, in the three East Asian countries of Korea, China, and Japan, shifts from a traditional dietary pattern

have been found. In Korea, the healthy dietary pattern "Korean healthy," which is high in intakes of vegetables, kimchi (spicy raw vegetables), seaweeds, beans, fruits, milk, and dairy products have been replaced with a dietary pattern high in beef, pork, poultry, fish, ice cream, sweet drinks, chocolate, sweet baked goods, and sugary foods.[11] In China, the traditional dietary pattern consisting of high intake of pork, rice, and vegetables has been replaced with a modern dietary pattern that is high in fruit, fast food, and processed meat.[10] In Japan, the traditional dietary pattern of rice, grains, miso soup, dashi soup (fermented soybeans), fish, seafood, sometimes meats, vegetables, wild plants, seaweed and shellfish has become predominated by more red meats, poultry, milk, eggs, fruit, vegetables, as well as processed food such as pasta, ham, bacon, catsup, and fruit vegetables.[9,12]

Dietary patterns can be efficacious indicators of the impact of diet on health outcomes. Determining the dietary patterns that exist in East Asian children and its relationships to indicators of health such as overweight/obese and waist circumference can be important to informing future efforts in health promotion within this population. The Children's Healthy Living Program (CHL) contains an extensive dataset which enables an analysis of dietary patterns of East Asian children living in the US Affiliated Pacific Region. This study seeks 1) to determine what dietary patterns occur in East Asian children 2 - 8 years of age residing in the US Affiliated Pacific Region, 2) to determine which dietary patterns contributes to a lower likelihood of being overweight or having obesity in children 2 - 8 years of age residing in the US Affiliated Pacific Region, and 3) to determine which dietary pattern contributes to a waist to height ratio below the cut off of 0.5 in East Asian children 2 - 8 years of age residing in the US Affiliated Pacific Region.

Methods

Study Design and Settings

This study is a secondary analysis of the CHL community randomized trial and prevalence study. CHL is a partnership among remote Pacific states and other jurisdiction of the US: Alaska, American Samoa, Commonwealth of the Northern Mariana Islands, Guam, Federated States of Micronesia, Hawai‘i, Republic of Palau, and the Republic of the Marshall Islands.[30] The community randomized trial was conducted in Guam, Hawai‘i, Alaska, the Commonwealth of the Northern Mariana Islands, and American Samoa.[30] Only time 1 data will be used in this analysis. Communities were identified in the intervention jurisdictions using the 2000 US Census tract data, since 2010 data was not available at the census tract level in 2011 when sites were selected. Communities eligible for the intervention had a population size >1000 (except for FAS), >25% of the population of indigenous/native descent (except 15% in Alaska due to no census tract with a population of more than 1000 having more than 25% indigenous/native) and >10% of the population under age 10 years (based on combining census tract data groups of < 5 years of age and 5 – 9 years of age and to have sufficient population size for CHL target of 2 to 8 year olds).[30]

Prevalence data was collected from the Republic of Palau, the Republic of the Marshall Islands, and the Federated States of Micronesia which include Pohnpei, Chuuk, Yap and Kosrae at Time 1.[30] The 2010 country census data were used to inform selection of sites for prevalence survey data collection. Further detail on the study has been published elsewhere.[30]

The number of participants that consented at Time 1 for CHL included a total of 5775 participants. To be eligible for this secondary analysis, participants must have identified as Chinese, Japanese, or Korean and have complete dietary intake and anthropometry information (n = 288).

Measurements

Dietary Intake

Dietary intake was assessed using dietary records. Parents/caregivers were asked to complete the dietary record for their child on two randomly assigned non-consecutive days, which included one weekday and one weekend. Parents/caregivers were trained on how to complete the food records and given calibrated utensils to assist with estimating portion sizes. Dietary data was entered using the Pacific Tracker 3 (PacTrac). PacTrac is a new dietary assessment program used to evaluate dietary data for nutrition studies in the Pacific Islands.[31] PacTrac3was used to calculate food groups, energy, and nutrient intakes.[31]

The CHL food record data was evaluated based on 29 food groups (see table 1). One food group alcohol (pyr102) was excluded because there was no consumption within this age group. Therefore, 29 food groups were used in this analysis. The units for the 29 food groups were in cup equivalents/day and were weighted for weekday/weekend days and adjusted for in-person variance.

Table 1. The 29 food groups that were used as predictors in the reduced rank regression analysis

Food group	Detailed list of foods
Added sugars	White sugar, brown sugar, raw sugar, corn syrup, corn syrup solids, high fructose corn syrup, malt syrup, maple syrup, pancake syrup, fructose sweetener, liquid fructose, honey, molasses, dextrose, and dextrin eaten separately or as ingredients in processed or prepared foods.
Cheese	Cheese: hard natural cheese, soft cheese, processed cheese, and cheese products.
Milk	Milk: fluid milk (cow, goat), chocolate milk, lactose-reduced milk, lactose-free milk, filled milk, dry milk, and evaporated milk.
Total milk	Includes cheese, milk, and yogurt
Yogurt	Yogurt: Includes all yogurts such as fat-free, low-fat, reduced-fat, and whole-milk yogurt.
Citrus fruits, melons, berries	Citrus fruits, melons, berries: Includes acerola, blackberries, blueberries, boysenberries, calamondin, cantaloupe, casaba melon, cranberries, dewberries, elderberries, gooseberries, grapefruit, huckleberries, honeydew melon, June berries, kiwifruit, kumquats, lemons, limes, loganberries, mandarin oranges, mulberries, oranges, raspberries, strawberries, tangelos, tangerines, ugli fruit, watermelon, youngberries, and juices made from these fruits.
Other fruits	Apples, apricots, Asian pears, avocados, bananas, cherries, currants, dates, figs, genip, guava, quinces, grapes, jackfruit, japanese pears, jobo, loquats, lychees, mamey (mamea) apple, mangoes, nectarines, papaya, passion fruit, peaches, pears, persimmons, plantains, pineapples, plums, pomegranates, prickly pears, prunes, raisins, red bananas, rhubarb, sapodilla, soursop (guanabana), star fruit (carambola), sweetsop, tamarind, watermelon rind, wi- apples, and juices made from these fruits.
Fruits	Includes citrus fruits, melons and berries, and other fruits
Non-whole grains	Grains from which bran and germ are removed in milling. Examples of refined grain products are white flour, degerminated cornmeal, white bread, white rice, and pearled barley.
Total grain	Includes non-whole grain plus total whole grain.
Whole grain	Whole grains contain the entire grain kernel (the bran, germ, and endosperm). Examples of whole grain foods in this database include

	whole-wheat flour, bulgur (cracked wheat), oatmeal, whole cornmeal, and brown rice
Eggs	Eggs and egg substitutes
Fish and shellfish	Includes cooked meat from fish, shellfish, and other seafood
Frankfurters, sausage, luncheon meats	Includes meat from frankfurters, sausages, and, luncheon meats
Meat	Meat from beef, pork, veal, lamb, and game, excluding that from organ meat and that from frankfurters, sausages, and luncheon meats
Total meat	Includes meat from fish and shellfish; frankfurters, sausages, and luncheon meat; beef, pork, veal, lamb, and game; organ meats; and poultry
Nuts and seeds	Nuts and seeds, where ½ ounce of nuts and seeds is 1-ounce equivalent of cooked lean meat.
Poultry	Chicken, turkey, and other poultry. Excludes poultry organ meats and poultry present in frankfurters, sausages, and luncheon meats
Soybean products	Tofu, meat analogs
Orange vegetables	Orange vegetables: calabaza, carrots, carrot juice, pumpkin, sweet potato, winter squash, yams.
Dark green vegetables	Arugula, balsam-pear tips, beet greens, bitter melon leaves, broccoli, chard, chicory, cilantro, collard greens, cress, dandelion greens, endive, escarole, grape leaves, kale, lambs quarters, mustard greens, mustard cabbage, parsley, poke greens, pumpkin leaves, romaine lettuce, spinach, sweet potato leaves, taro leaves, turnip greens, watercress.
Dry beans and peas	Bayo beans, black beans, black-eyed peas, broad beans, calico beans, chickpeas (garbanzos), cowpeas, fava beans, kidney beans, lentils, lima beans (mature), mongo beans, mung beans, navy beans, pinto beans, pink beans, red Mexican beans, split peas, soybeans (mature)

Other vegetables	Algae, aloe vera juice, artichoke, asparagus, balsam-pear pods, bamboo shoots, bean and alfalfa sprouts, broccoflower, beets, Brussels sprouts, buckwheat sprouts, cabbage (green and red), cactus, capers, cauliflower, celeriac, celery, celery juice, chayote, Chinese cabbage, chives, christophine, chrysanthemum, coriander, cucumber, eggplant, fern shoots, garlic, ginger root, green beans, horseradish, jute (potherb), kohlrabi, leek, lettuce, lotus root, luffa (Chinese okra), mushrooms, nopales, okra, olives, onions (mature and green), oriental radishes, palm hearts, peppers (green, red, hot, banana), pimiento, pumpkin flowers, radicchio, radishes, sauerkraut, seaweed, sequin (Portugese cabbage), snow peas, summer squash, string beans (yellow), swamp cabbage, tomatillo, tree fern, turnips, water chestnuts, wax beans, wax gourd, winter melon, zucchini.
White potatoes	White potatoes
Other starchy vegetables	Black-eyed peas (not dried), breadfruit, burdock, casabe, cassava, corn, cowpeas (not dried), dasheen, green peas, hominy, jicama, lima beans (immature), parsnips, pigeon peas, poi, salsify, rutabaga, tannier, taro, yam bean.
Tomatoes	Tomatoes and tomato vegetable juice
Total vegetables	Orange vegetables, dark green vegetables, other vegetables, white potatoes, other starchy vegetables, and tomatoes. Dry beans and peas not included
Discretionary solid fat	Solid fats are fats that are solids at room temperature.
Equivalents from discretionary solid fat, added sugars and alcoholic beverages	Equivalents from discretionary fat (in grams), added sugars (in tsp of table sugar), and alcohol (in total drinks): Contains only the solid fat, added sugar, or alcohol components of foods. Includes foods such as candies, sodas, alcoholic beverages, and solid fats which provide energy and little else nutritionally.

Anthropometry

Body size measures included weight, height and waist circumference (WC) at the level of the umbilicus. Trained and standardized staff used standardized instruments to assess weight (Seca Model 876), stadiometers for height (Perspective Enterprises Model 101), and tape measures for waist circumference (Seca Model 201).[32] Mean height and weight were used to calculate body mass index (BMI; weight (kg) / height $(m)^2$).[32] Overweight was defined as the 85th - 94th BMI percentile and obesity was defined as greater than or equal to the 95th percentile for BMI.[32] For this study, overweight and obesity (OWOB) was combined and used in analysis. Waist-to-height ratio (WHtR) has been shown to be a good predictor of general/central adiposity.[26] This anthropometric measure can be calculated by dividing WC by height.[26,27] It is a simple-independent marker to prevent the need for age-related reference charts in different ethnic/gender groups.[26,27] Previous research in children has indicated that the optimal cut off value was 0.5.[26,27] The study applied the 0.5 cutoff for WHtR ratio.

Other Information

Caregivers completed a demographic form in which demographic information such as age, sex and race/ethnicity of the child was reported. Caregivers could check which ethnicities the child identified based on the six categories: AIAN (American Indian and Alaska Native), Asian, Black, NHPI (Native Hawaiian and Other Pacific Islanders), White, or more than one race. Of those categories, caregivers could specify which Asian their child identified such as Chinese, Filipino, Indian, Japanese, Thai, etc.

Ethics Approval

Institutional review board approval was obtained from the University of Hawai‘i at Mānoa, University of Guam and University of Alaska. Northern Marianas College and American Samoa Community College ceded approval to the University of Hawai‘i at Mānoa. Written informed consent and assent were obtained from the caregiver and assent from the child participant.

Analysis

Children who were not Chinese, Japanese, or Korean, did not have a diet record, and were missing height, weight, or waist were not included in the study. The mean height, weight, WHtR, BMI and BMI percentile of the children were calculated. The proportion of boys and girls and those children who were identified as Chinese, Korean and/or Japanese were determined. The mean for food energy, saturated fat, carbohydrate, and sugar sweetened beverages (SSB) weighted for weekday/weekend and adjusted for in-person variance was calculated as well.

Reduced rank regression (RRR) was used to derive the dietary patterns. RRR is a statistical method that determines linear functions of predictors (foods) by maximizing the explained variation responses (disease-related nutrients).[33] RRR is neither an a priori nor a purely exploratory statistical method.[33] It uses both information sources, data from the study and prior information for defining responses; it represents a so-called posteriori method.[33] RRR allows for the calculation of dietary pattern scores similarly to those extracted by factor analysis.[33] However, factor analysis determines dietary pattern scores by maximizing the explained variation of a set of predictor variables (e.g. food groups), RRR derives dietary pattern scores of predictor variables by accounting for as much of the variation in response variables (e.g.

nutrients related to weight) as possible.[33,34] The total fat, total carbohydrates, and sugar sweetened beverage intake (g/day) were selected as response variables because these variables have been associated with OWOB and central adiposity.[35–38] The food groups served as the predictor variables. RRR summarizes the food groups into distinct dietary patterns that capture the variation in the nutrient densities of total fat, total carbohydrates, and sugar (i.e. response variables). In RRR, the number of extracted dietary patterns cannot be higher than the number of selected response variables (i.e., total fat, total carbohydrates, and sugar); therefore, 3 dietary patterns will be obtained.[33,34]

Factor loadings reflect the correlation of individual food groups within each of the derived patterns. These factor loadings were acquired from the RRR. Food groups with an absolute factor loading greater than | 0.2 | were only considered. The dietary patterns were labeled based on the food groups which made the cutoff of 0.2. A dietary pattern score was calculated from the RRR based on the derived dietary pattern. Food groups with an absolute factor loading < | 0.2 | would not add to the dietary pattern score. The scores for each dietary pattern were converted into tertiles for further analysis. Thus, for each dietary pattern tertile 3 was composed of those who conform most (e.g. consume the most) to that particular pattern while quartile 1 was the lowest conformers (e.g. consume the least).[33,34]

To assess the relationship between OWOB and WHtR, dietary scores were converted into tertiles and multiple logistic regression models were used. Separate binary logistic regression models were conducted with OWOB or WHtR as the dependent variables. The logistic regression was examined without adjusting for age and sex first. If the results showed significance, the model

was adjusted for age and sex to determine if the observed association was related to child age or sex.

All RRR analyses were conducted using Statistical Analysis Software 9.4 (SAS). All other analyses were performed using Statistical Package for the Social Sciences (SPSS) version 25.0 (Armonk, New York). Results were considered significant at $P < 0.05$ to accept or reject the hypotheses.

Results

This study included 302 children who were identified as Chinese, 235 as Japanese, and 48 as Korean (see figure 3). Of these only 288 participants had diet data and OWOB information while 282 participants had diet data and WHtR information. The average age of the children was 61.5 months (5 years old) (SD = 21.06). 71 children (25.2%) were classified as overweight or obese and 211 children were classified as having a healthy weight (74.8%). The mean waist to height ratio was 0.51 (SD = 0.045). There were 135 (46.9%) boys and 153 (53.1%) girls in the study. The mean height was 108.55 cm (SD = 12.29), mean weight was 20.05 kg (SD = 6.44), mean waist was 54.73 cm (SD = 7.02), mean BMI was 16.66 (SD = 2.18), and mean BMI percentile was 62.88% (SD =27.44) (see table 2).

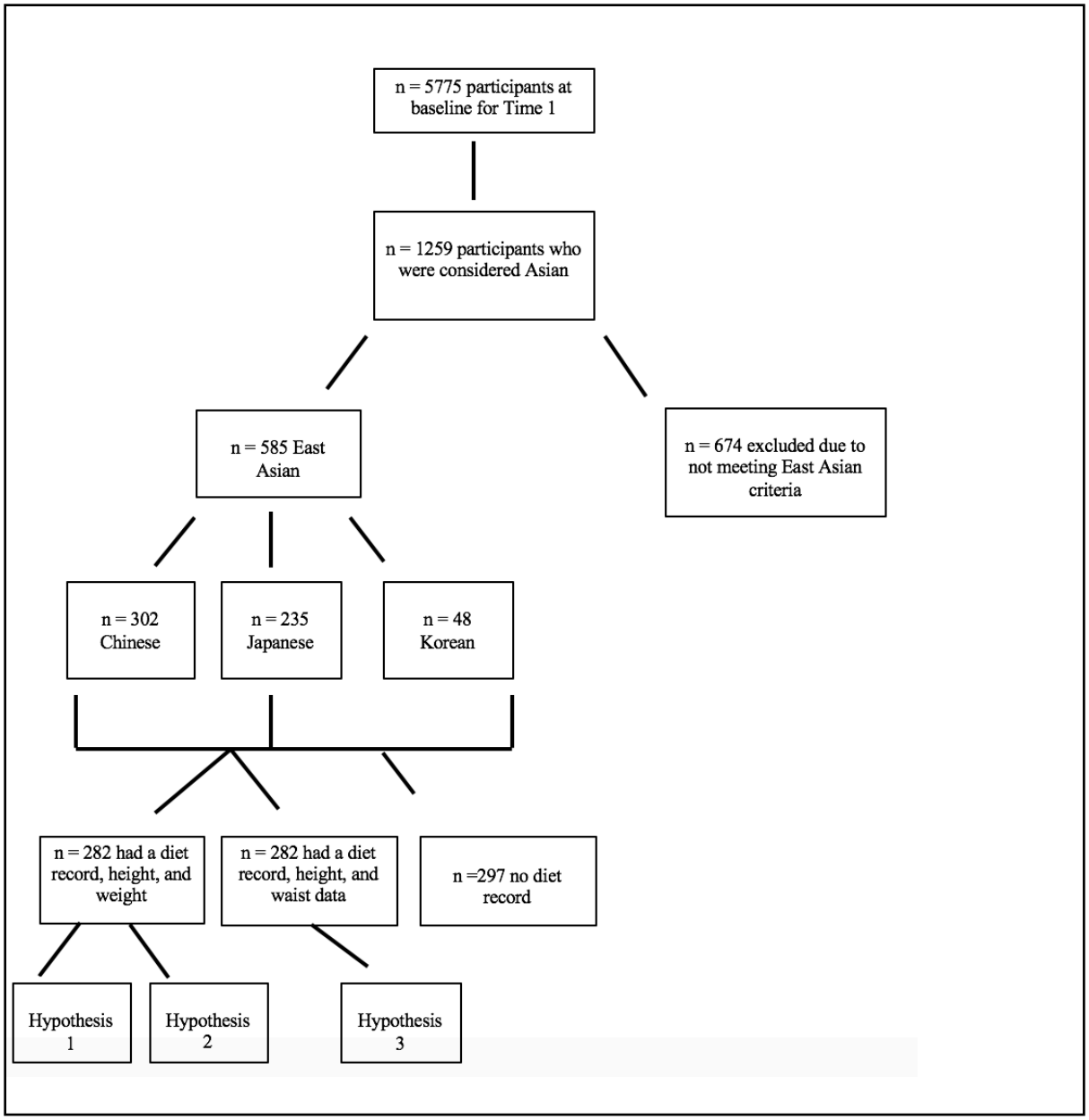


Figure 3: Flowchart which identifies the total sample size that was used in this study at Time 1 from the Children's Healthy Living Program

Table 2: Descriptive statistics of participants age 2-8 that were East Asian from the Children's Healthy Living Program (n=288)

Variables	Mean	SD
Height (cm)	108.55	12.29
Weight (kg)	20.05	6.44
Waist (cm)	54.73	7.02
Waist-to-height ratio	0.5057	0.045
BMI[a]	16.66	2.18
BMIpct[b]	62.88	27.44
Age (months)	61.59	21.06
	n	%
Boy	131	46.9%
Girl	153	53.1%
Chinese	302	51.6%
Japanese	235	40.2%
Korean	48	8.2%

[a] Body Mass Index (BMI) Categories was defined using sex- and age-specific BMI cut-points from the Centers for Disease Control and Prevention Growth Charts.
[b]BMIpct = BMI percentile

The mean food energy was 1598.88 kcal (SD = 567.46 kcal), carbohydrate mean was 210.80 g (SD = 78.14 g), saturated fat mean was 20.23 g (SD = 11.2 g), monounsaturated fat mean was 21.45 g (SD = 9.55 g), sugar sweetened beverages (SSB) mean was 0.87 cups (SD = 1.1 cups), and 211.04 g (SD = 266.04 g) (see table 3).

Table 3: Mean and Standard Deviation (SD) of food energy, carbohydrate, saturated fat, monounsaturated fat, and sugar sweetened beverages (SSB) intake of study participants ages 2-8 (n=288)

	Mean	SD
Food energy[a]	1598.88 kcal	567.46 kcal
Carbohydrate[a]	210.80 g	78.14 g
Saturated fat[a]	20.23 g	11.2 g
Monounsaturated fat[a]	21.45 g	9.55 g
SSB portion in cups[b]	0.87 cups	1.1 cups
SSB portion in grams[b]	211.04 g	266.04 g

[a] Weighted for weekday/weekend days

[b] Weighted for weekend/weekend days and adjusted for within person variance

Foods with a factor loading above | 0.2 |, which indicates the level of correlation to the derived dietary patterns, are shown in table 4. A traditional dietary pattern was not apparent in any of the patterns from the RRR. For dietary pattern 1, added sugars, milk products, non-whole refined grains, whole grains, meat, and discretionary solid fat explained most of the variation between the response variables and predictors in the total sample. Dietary pattern 2 loaded only on added sugars but negatively loaded on milk and milk products, nuts and seeds, and solid fat. Dietary pattern 3 loaded on nuts and seeds but negatively loaded on other fruits, total fruits, non-whole refined grain, total grain, whole grain, dark green vegetables, and nuts and seeds.

None of the three dietary patterns demonstrated a significant association with OWOB using logistic regression (table 5). For WHtR, there was also no association between the derived dietary patterns and WHtR (see table 6).

Table 4: Factor-loading matrix for the three dietary patterns and their food or food groups identified in 288 East Asian children participating in Time 1 of the Children's Healthy Living Program[a]

	Dietary pattern 1 (Dairy, grains, meat, sugar, and fat)	Dietary pattern 2 (High sugar)	Dietary pattern 3 (Nuts and seeds)
Added sugars	0.373109	0.472833	
Cheese			
Milk		-0.312606	
Total milk	0.202513	-0.334994	
Yogurt			
Citrus fruits, melons, berries			
Other fruits			-0.36675
Total fruits			-0.342561
Non-whole refined grain	0.335521		-0.316655
Total grain	0.327141		-0.328258
Whole grain			-0.261739
Eggs			
Shellfish			
Processed meat			
Meat			
Total meat	0.207299		
Nuts and seeds		-0.345456	0.233228
Poultry			
Soybean products			
Orange vegetables			-0.326091

Dark green vegetables			
Dry beans and peas			-0.230091
Other vegetables			
White potatoes			
Other starchy vegetables			
Tomatoes (including juice)			
Total vegetables			
Solid fat	0.375065	-0.380942	
Discretionary solid fat, added sugars, and alcoholic	0.433123		
% Variance explained	50.92	18.48	7.77
Total	∑ = 77.17		

[a]Factor loadings |>0.2| were only considered

Table 5: Unadjusted odds ratio of the relationship between the derived dietary patterns and overweight and obesity (OWOB) computed from this study (n=288)

Unadjusted Models[a]	B[b]	Sig[c]	Exp(B)[d]
Dietary Pattern 1 (tertile 2)	-0.123	0.726	0.885
Dietary Pattern 1 (tertile 3)	0.0379	0.252	1.460
Dietary Pattern 2 (tertile 2)	0.285	0.400	1.329
Dietary Pattern 2 (tertile 3)	0.175	0.608	1.192
Dietary Pattern 3 (tertile 2)	-0.259	0.461	0.712
Dietary Pattern 3 (tertile 3)	0.336	0.306	1.399

[a] Tertile 1 = reference

[b] B = slope

[c] Sig = Significance $p<0.05$

[d] Exp(B) = Odds ratio

Table 6: Unadjusted odds ratio of the relationship the relationship between the derived dietary patterns and waist to height ratio (WHtR) computed from this study (n=282)

Unadjusted Models[a]	B[b]	Sig[c]	Exp(B)[d]
Dietary Pattern 1 (tertile 2)	0.299	0.307	1.349
Dietary Pattern 1 (tertile 3)	0.000	1.000	1.000
Dietary Pattern 2 (tertile 2)	0.085	0.770	1.089
Dietary Pattern 2 (tertile 3)	-0.170	0.560	0.843
Dietary Pattern 3 (tertile 2)	0.233	0.424	1.262
Dietary Pattern 3 (tertile 3)	0.322	0.273	1.380

[a] Tertile 1 = reference

[b] B = slope

[c] Sig = Significance $p<0.05$

[d] Exp(B) = Odds ratio

Discussion

Among this sample of children participating in the CHL study, a traditional East Asian dietary pattern predominant in rice, noodles, seafood or animal protein, and vegetables did not emerge using the RRR method. However, the individual food groups of non-whole refined grains and whole grains, which noodles and rice would be classified, as well as meat did emerge in Dietary pattern 1. The other foods indicative of a traditional East Asian diet such as seafood and vegetables did not emerge in Dietary pattern 1. This could suggest that the variance was not great

enough for traditional foods to emerge as an influential pattern or it is possible that these traditional foods were simply not eaten during the data collection periods.

A traditional East Asian diet also may not have been found due to race and ethnic mixing. As documented elsewhere, the CHL study included a high proportion of children who were identified as more than one race/ethnicity.[39] For example, one of the publications from CHL documented that approximately 20% of the children sampled were more than one race.[39] CHL adapted the race categorizations of the US Office of Management and Budget (OMB) guidelines (American Indian and Alaska Native, Asian, Black, Native Hawaiian and Pacific Islander, White, and More than one Race) to include additional options for identifying ethnic groups within the Asian (e.g., Chinese, Filipino, Japanese, Korean) and the Native Hawaiian and Pacific Islander (e.g., Chamorro, Native Hawaiian, Samoan) categories.[40] With the high proportion of racial and ethnic mixing in the region as documented by CHL[39], children may not have consumed a traditional East Asian diet because their diet may be reflective of their other ethnicity(ies) as well.[40]

This study used the geographical locations of East Asia to define East Asian. However, other factors may influence an individual's dietary preference. External factors such as the social environment, physical environment, or food likes could be influential factors.[41] For example, the physical environment could be defined as availability of foods, accessibility, or selection of foods in stores may impact an individual's diet. Therefore, an individual's race/ethnicity may not be an indicator of consuming a traditional East Asian dietary pattern.

Different cut points for OWOB have been proposed to be applied in the adult Asian population. In the US, Asian American adults have a lower prevalence of OWOB defined by the standard BMI cut points compared to non-Hispanic whites.[42] Additionally, Asian American adults may be classified in the healthy BMI range but have higher rates of diabetes.[42] Cut points of 23 kg/m^2 for overweight and 27.5 kg/m^2 for obesity may be better correspondents among Asian American adults as Asians may have lower BMI but higher visceral adipose tissue compared to non-Hispanic Whites.[42,43] In the UK, the suggested BMI threshold for defining OWOB in South Asian children would be ~3 kg/m^2 lower.[44] Therefore, the selected OWOB cut points may have impacted the results. Although, there was no evidence presented in this study that East Asian children should apply a different cut point.

RRR seeks to capture the variation in intake with regard to certain response variables.[22] In this study, total carbohydrate, saturated fat, and sugar were used as the response variables to maximize the explained variation among the dietary patterns. Carbohydrate, saturated fat, and sugar were variables that contributed OWOB and central adiposity, not a traditional dietary pattern. Different response variables could have been used to detect a traditional dietary pattern. Response variables such as fiber, omega-3, iron, and calcium could have been used. These nutrients are commonly present in the traditional dietary patterns of China, Japan and Korea.[45] Non-heme iron/heme iron for example, is provided through dark green vegetables and animal protein.[45] Additionally, using SSB as a response variable may have been the driving factor to determine dietary pattern 2 (added sugars). However, dietary pattern 2 only explained 18.48% of the variance and this response variable was chosen because there has been extensive literature explaining the association between SSB and OWOB.[38,46] Therefore, using different response

variables in the RRR may have identified an East Asian diet and influenced the resulting dietary patterns.

Other methods such as principal component analysis (PCA) or cluster analysis (CA) could have been used to see if a traditional dietary pattern emerged. Both methods have been used extensively for examining dietary patterns.[47] PCA uses the correlation matrix of food intake variables to identify common patterns of food consumption within the data to find the largest amount of variation in diet.[47] PCA can explain a high proportion of the variability in dietary intake and can describe actual dietary patterns of the population, however, these patterns may be poorly related to disease.[47] CA groups individuals who have similar dietary patterns into mutually exclusive categories according to the mean of the food intake variables.[47] Another method, partial least squares (PLS) combines the strengths of PCA and RRR. This method strives to identify patterns that maximize the variance explained in both dietary intake and the intermediary response variables related to the health or disease outcome.[48] All four methods, PCA, CA, RRR, and PLS could have been used in comparison of each other when detecting traditional dietary patterns.

For future research investigating the relationship between acculturation and nutrition transition, additional methods for detection could be included. The CHL study did assess acculturation (immigration variables, language question, education question, and acculturation scale[16]) but the data from that form was not used in this analysis as the intent was to focus on the diet data. Future study could consider using the responses to the acculturation form as response variables for determining dietary patterns using RRR. Other research has been done to examine the

association between indicators of acculturation such as parental duration of residency, language, or generation status and changes in dietary patterns.[3]

The literature suggests that children are increasingly eating more added sugars, refined grains, meat, and fat.[9–11,22,49,42] The literature also has reported milk to be the most commonly consumed item, following fruit (more specifically orange juice), meat, unenriched white rice, and vegetables among Southeast Asian children.[22] Chinese American children reported that eating approximately seven high-fat and high-sugar items every day.[22] The results of this study found that a dietary pattern of added sugars, refined grains, meat, and fat explained the most variation which aligns with other research.

One strength of this study is that this is the first study about dietary patterns using the extensive dataset from the CHL. Another strength of this study was the rigorous study protocols applied by CHL for data collection. One limitation to this study is that this was a secondary analysis, so the study wasn't sampled to be representative of East Asians in the region. Another limitation is that this study is only a cross-sectional analysis which can only establish an association. PCA, CA, and PLS methods could have been used additionally to detect dietary patterns as well. The study didn't factor in physical activity level which may have also affected BMI and waist circumference.

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CHAPTER 3: CONCLUSION

The study investigated the dietary patterns that existed in East Asian children ages 2-8y living in the US Affiliated Pacific Region. A traditional East Asian dietary pattern was not identified in the children, rather, more Westernized foods were consumed such as added sugars, dairy, meat, and non-whole refined grains. The study aligns with other research showing that children consume more Westernized foods and not traditional foods.[9–11,50] The consumption of less traditional foods may indicate a nutritional transition is occurring in the East Asian US Affiliated Pacific Region community. There was no association found between any of the dietary patterns and (OWOB) and waist-to-height ratio (WHtR).

This study contributed to the limited research examining childhood obesity and diet in East Asian children in the US Affiliated Pacific Region. This study can spur further investigation about possible protective benefits of a traditional East Asian diet.

Examining the dietary patterns of children from this study can inform future research. Possible research activities should include (1) exploring other methods to identify a traditional East Asian dietary patterns, (2) examining the resulting dietary patterns association with OWOB and WHtR, (3) analyzing acculturation data collected in CHL with OWOB and WHtR, (4) studying generational status and the occurrence of nutrition transition, and (5) exploring other factors like socioeconmic status may influence dietary behavior in East Asian children. This study has only scratched the surface of investigating children and their dietary patterns in the USAP. With childhood obesity a global public health concern, more research is needed to address this problem.

References

1. Budiman, Abby, Ruiz, Neil G. Data on Asian Americans. Pew Research Center's Social & Demographic Trends Project. Accessed June 1, 2021. https://www.pewresearch.org/social-trends/fact-sheet/asian-americans-chinese-in-the-u-s/

2. Budiman, Abby, Ruiz, Neil G. Data on Asian Americans. Pew Research Center's Social & Demographic Trends Project. Accessed June 1, 2021. https://www.pewresearch.org/social-trends/fact-sheet/asian-americans-japanese-in-the-u-s/

3. Zhang Q, Liu R, Diggs LA, Wang Y, Ling L. Does acculturation affect the dietary intakes and body weight status of children of immigrants in the U.S. and other developed countries? A systematic review. *Ethn Health*. 2019;24(1):73-93. doi:10.1080/13557858.2017.1315365

4. Childhood Obesity Facts | Overweight & Obesity | CDC. Published April 5, 2021. Accessed June 7, 2021. https://www.cdc.gov/obesity/data/childhood.html

5. Singh GK, Yu SM, Kogan MD. Health, Chronic Conditions, and Behavioral Risk Disparities among U.S. Immigrant Children and Adolescents. *Public Health Rep*. 2013;128(6):463-479. doi:10.1177/003335491312800606

6. Chen L, Juon H-S, Lee S. Acculturation and BMI Among Chinese, Korean and Vietnamese Adults. *J Community Health*. 2012;37(3):539-546. doi:10.1007/s10900-011-9476-1

7. Kiprop V. Which Countries Are Part of East Asia? WorldAtlas. https://www.worldatlas.com/articles/which-countries-are-part-of-east-asia.html. Published August 3, 2018. Accessed April 28, 2020.

8. Gong S, Wang K, Li Y, Alamian A. The influence of immigrant generation on obesity among Asian Americans in California from 2013 to 2014. Schooling CM, ed. *PLOS ONE*. 2019;14(2):e0212740. doi:10.1371/journal.pone.0212740

9. Taha FA. Japan adds western flavor to its traditional diet. *Food Review*. 1993;16(1):30-37.

10. Xu X, Hall J, Byles J, Shi Z. Dietary Pattern Is Associated with Obesity in Older People in China: Data from China Health and Nutrition Survey (CHNS). *Nutrients*. 2015;7(9):8170-8188. doi:10.3390/nu7095386

11. Shin KO, Oh SY, Park HS. Empirically derived major dietary patterns and their associations with overweight in Korean preschool children. *Br J Nutr*. 2007 Aug;98(2):416-21. doi: 10.1017/S0007114507720226. Epub 2007 Apr 16. PMID: 17433127.

12. Ana Gabriel, Kumiko Ninomiya, Hisayuki Uneyama. The Role of the Japanese Traditional Diet in Healthy and Sustainable Dietary Patterns around the World. *Nutrients*. 2018;10(2):173. doi:10.3390/nu10020173

13. Papanikolaou Y, Jones JM, Fulgoni VL. Several grain dietary patterns are associated with better diet quality and improved shortfall nutrient intakes in US children and adolescents: a study focusing on the 2015–2020 Dietary Guidelines for Americans. *Nutr J*. 2017;16(1):13. doi:10.1186/s12937-017-0230-0

14. U.S. Department of Agriculture and U.S. Department of Health and Human Services. Dietary Guidelines for Americans, 2020-2025. 9th Edition. December 2020. Available at DietaryGuidelines.gov.

15. Caballero B, Clay T, Davis SM, et al. Pathways: a school-based, randomized controlled trial for the prevention of obesity in American Indian schoolchildren. *Am J Clin Nutr*. 2003;78(5):1030-1038.

16. Novotny R, Williams AE, Vinoya AC, Oshiro CES, Vogt TM. US Acculturation, Food Intake, and Obesity among Asian-Pacific Hotel Workers. *J Am Diet Assoc*. 2009;109(10):1712-1718. doi:10.1016/j.jada.2009.07.013

17. Rovillé-Sausse FN. Westernization of the nutritional pattern of Chinese children living in France. *Public Health (Elsevier).* 2005;119(8):726-733. Accessed October 1, 2019.

18. van Hook J, Baker E. Big Boys and Little Girls: Gender, Acculturation, and Weight among Young Children of Immigrants. *J Health Soc Behav*. 2010;51(2):200-214.

19. Schaefer SE, Salazar M, Bruhn C, Saviano D, Boushey C, Van Loan MD. Influence of race, acculturation, and socioeconomic status on tendency toward overweight in Asian-American and Mexican-American early adolescent females. *J Immigr Minor Health*. 2009;11(3):188-197. doi:10.1007/s10903-008-9150-6

20. Huang ZJ, Zheng C. Type 2 Diabetes among 6 Asian Ethnic Groups in California: The Nexus of Ethnicity, Gender, and Generational Status. *J Health Care Poor Underserved*. 2015;26(2 Suppl):16-35. doi:10.1353/hpu.2015.0061

21. Antecol H, Bedard K. Unhealthy assimilation: why do immigrants converge to American health status levels? *Demography*. 2006;43(2):337-360. doi:10.1353/dem.2006.0011

22. Diep CS, Foster MJ, McKyer ELJ, Goodson P, Guidry JJ, Liew J. What are Asian-American Youth Consuming? A Systematic Literature Review. *J Immigr Minor Health*. 2015;17(2):591-604. doi:10.1007/s10903-013-9905-6

23. Demory-Luce DK, Morales M, Nicklas T. Acculturation, weight status, and eating habits among Chinese-American preschool children and their primary caregivers: a pilot study. *Nutr Res*. Published online 2005:12.

24. Amirabdollahian F, Haghighatdoost F. Anthropometric Indicators of Adiposity Related to Body Weight and Body Shape as Cardiometabolic Risk Predictors in British Young Adults: Superiority of Waist-to-Height Ratio. *J Obes*. 2018;2018:8370304. doi:10.1155/2018/8370304

25. Flegal KM, Ogden CL, Yanovski JA, et al. High adiposity and high body mass index–for-age in US children and adolescents overall and by race-ethnic group. *Am J Clin Nutr*. 2010;91(4):1020-1026. doi:10.3945/ajcn.2009.28589

26. Kılınç A, Çöl N, Demircioğlu-Kılıç B, Aydin N, Balat A, Keskin M. Waist to height ratio as a screening tool for identifying childhood obesity and associated factors. *Pak J Med Sci*. 2019;35(6). doi:10.12669/pjms.35.6.748

27. Fujita Y, Kouda K, Nakamura H, Iki M. Cut-off Values of Body Mass Index, Waist Circumference, and Waist-to-Height Ratio to Identify Excess Abdominal Fat: Population-Based Screening of Japanese Schoolchildren. *J Epidemiol*. 2011;21(3):191-196. doi:10.2188/jea.JE20100116

28. Budiman A, Ruiz NG, Inquiries D 20036USA202-419-4300 | M-857-8562 | F-419-4372 | M. Asian Americans are the fastest-growing racial or ethnic group in the U.S. Pew Research Center. Accessed June 12, 2021. https://www.pewresearch.org/fact-tank/2021/04/09/asian-americans-are-the-fastest-growing-racial-or-ethnic-group-in-the-u-s/

29. Budiman, Abby. Data on Asian Americans. Pew Research Center's Social & Demographic Trends Project. Accessed June 25, 2021. https://www.pewresearch.org/social-trends/fact-sheet/asian-americans-koreans-in-the-u-s/

30. Wilken LR, Novotny R, Fialkowski MK, et al. 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*. 2013;13(1):944. doi:10.1186/1471-2458-13-944

31. Martin CL, Murphy SP, Leon Guerrero RT, Davison N, Jung YO, Novotny R. The Pacific Tracker (PacTrac): Development of a dietary assessment instrument for the Pacific. *J Food Compos Anal*. 2008;21(Suppl 2):S103-S108. doi:10.1016/j.jfca.2007.06.007

32. Li F, Wilkens LR, Novotny R, et al. Anthropometric measurement standardization in the US-affiliated pacific: Report from the Children's Healthy Living Program: Anthropometric Measurement Standardization. *Am J Hum Biol*. 2016;28(3):364-371. doi:10.1002/ajhb.22796

33. Hoffmann K. Application of a New Statistical Method to Derive Dietary Patterns in Nutritional Epidemiology. *Am J Epidemiol*. 2004;159(10):935-944. doi:10.1093/aje/kwh134

34. Fialkowski MK, McCrory MA, Roberts SM, Tracy JK, Grattan LM, Boushey CJ. Dietary patterns are associated with dietary recommendations but have limited relationship to BMI in the Communities Advancing the Studies of Tribal Nations Across the Lifespan

(CoASTAL) cohort. *Public Health Nutr*. 2012;15(10):1948-1958. doi:10.1017/S1368980012000122

35. Nasreddine L, Naja F, Akl C, et al. Dietary, Lifestyle and Socio-Economic Correlates of Overweight, Obesity and Central Adiposity in Lebanese Children and Adolescents. *Nutrients*. 2014;6(3):1038-1062. doi:10.3390/nu6031038

36. Nettleton JA, Steffen LM, Schulze MB, et al. Associations between markers of subclinical atherosclerosis and dietary patterns derived by principal components analysis and reduced rank regression in the Multi-Ethnic Study of Atherosclerosis (MESA). *Am J Clin Nutr*. 2007;85(6):1615-1625. doi:10.1093/ajcn/85.6.1615

37. Imamura F, O'Connor L, Ye Z, et al. Consumption of sugar sweetened beverages, artificially sweetened beverages, and fruit juice and incidence of type 2 diabetes: systematic review, meta-analysis, and estimation of population attributable fraction. *Br J Sports Med*. 2016;50(8):496-504. doi:10.1136/bjsports-2016-h3576rep

38. Suara SB, Siassi F, Saaka M, Rahimi Foroshani A, Sotoudeh G. Association between Carbohydrate Quality Index and general and abdominal obesity in women: a cross-sectional study from Ghana. *BMJ Open*. 2019;9(12). doi:10.1136/bmjopen-2019-033038

39. Novotny R, Li F, Leon Guerrero R, et al. Dual burden of malnutrition in US Affiliated Pacific jurisdictions in the Children's Healthy Living Program. *BMC Public Health*. 2017;17(1):483. doi:10.1186/s12889-017-4377-6

40. Novotny R, Davis J, Butel J, et al. Effect of the Children's Healthy Living Program on Young Child Overweight, Obesity, and Acanthosis Nigricans in the US-Affiliated Pacific Region: A Randomized Clinical Trial. *JAMA Netw Open*. 2018;1(6):e183896. doi:10.1001/jamanetworkopen.2018.3896

41. Eertmans A, Baeyens F, Van den Bergh O. Food likes and their relative importance in human eating behavior: review and preliminary suggestions for health promotion. *Health Educ Res*. 2001;16(4):443-456. doi:10.1093/her/16.4.443

42. Jih J, Mukherjea A, Vittinghoff E, et al. Using appropriate body mass index cut points for overweight and obesity among Asian Americans. *Prev Med*. 2014;65:1-6. doi:10.1016/j.ypmed.2014.04.010

43. Park Y-W, Allison DB, Heymsfield SB, Gallagher D. Larger Amounts of Visceral Adipose Tissue in Asian Americans. *Obes Res*. 2001;9(7):381-387. doi:10.1038/oby.2001.49

44. Hudda MT, Donin AS, Owen CG, et al. Exploring the use of adjusted body mass index thresholds based on equivalent insulin resistance for defining overweight and obesity in UK South Asian children. *Int J Obes 2005*. 2019;43(7):1440-1443. doi:10.1038/s41366-018-0279-7

45. Asian Diet. Jackson Siegelbaum Gastroenterology. Published October 29, 2011. Accessed June 22, 2021. https://www.gicare.com/gi-health-resources/asian-diet/

46. Koebnick C, Black MH, Wu J, et al. A diet high in sugar-sweetened beverage and low in fruits and vegetables is associated with adiposity and a pro-inflammatory adipokine profile. *Br J Nutr*. 2018;120(11):1230-1239. doi:10.1017/S0007114518002726

47. Newby PK, Tucker KL. Empirically Derived Eating Patterns Using Factor or Cluster Analysis: A Review. *Nutr Rev*. 2004;62(5):177-203. doi:10.1111/j.1753-4887.2004.tb00040.x

48. Naja F, Itani L, Hwalla N, Sibai AM, Kharroubi SA. Identification of dietary patterns associated with elevated blood pressure among Lebanese men: A comparison of principal component analysis with reduced rank regression and partial least square methods. *PLoS ONE*. 2019;14(8):e0220942. doi:10.1371/journal.pone.0220942

49. Malik VS, Pan A, Willett WC, Hu FB. Sugar-sweetened beverages and weight gain in children and adults: a systematic review and meta-analysis123. *Am J Clin Nutr*. 2013;98(4):1084-1102. doi:10.3945/ajcn.113.058362

50. Diep CS, Leung R, Thompson DI, Gor BJ, Baranowski T. Culture and Diet Among Chinese American Children Aged 9–13 Years: A Qualitative Study. *J Nutr Educ Behav*. 2017;49(4):275-284.e1. doi:10.1016/j.jneb.2016.11.002