BEVERAGE CONSUMPTION AND THE INCIDENCE OF OVERWEIGHT AND OBESITY IN AN INDIANAPOLIS WIC POPULATION

Joshua J. Foster

Submitted to the faculty of the University Graduate School
in partial fulfillment of the requirements
for the degree
Masters of Science
in the School of Health and Rehabilitation Sciences
Indiana University

January 2017

Accepted by the Graduate Faculty, Indiana University, in partial fulfillment of the requirements for degree of Masters of Science.

Master's Thesis Committee

____
Jaquelynn O'Palka, PhD, RDN, Committee Chair

____
Sara Blackburn, RD, DSc, D.D

____
Wei Li, MD, PhD

Acknowledgements

I would like to thank Indiana University Purdue University Indianapolis in allowing me to complete my master's degree at their institution. I would like to thank my professors Jacquelynn O'Palka and Sara Blackburn, and Dr. Wei Li for agreeing to be on my thesis committee and providing help and feedback that allowed me to complete my thesis. I would also like to thank the Marion County Public Health Department in allowing my study to progress using the WIC population and providing helpful critiques to my study design.

Joshua J. Foster

BEVERAGE CONSUMPTION AND THE INCIDENCE OF OVERWEIGHT AND OBESITY IN AND INDIANAPOLIS WIC POPULATION

The incidence of overweight and obesity in children and adolescence is a global health concern. The long term health implications of overweight or obesity include respiratory issues, mobility joint issues, cardiovascular disease, type II diabetes, and certain types of cancer. The incidence of overweight and obesity is more common in low socioeconomic populations. Though there are many factors influencing children who become overweight or obese, beverage consumption is of particular interest since it is hypothesized that the energy supplied by beverages is not compensated by energy intake from the rest of the diet.

Jacquelynn O’Palka , PhD, RDN, Committee Chair

Table of Contents

Specific Aim(s)

Is there a relationship between high intake of energy containing beverages in children 2-4 years of age in an urban Midwest population and the incidence of overweight and obesity as determined by 2000 CDC growth charts and parental food frequency questionnaire.

Definition of Terms:

1) Beverage intake categories used: milk, 100% fruit juice, fruit drink, (soda pop) soft drinks, tea/coffee, sports drinks, and nutritional supplements.
2) Overweight and obesity is determined by height and weight measurements utilizing 2000 Center for Disease Control and Prevention (CDC) Growth Charts.
3) Sugar Sweetened Beverages (SSBs): Any beverage with added sugars such as soda pop (soft drinks, sweetened tea, sports drinks, fruit drinks (non-100% juice).
4) Supplemental Nutrition Program for Women, Infants, and Children (WIC): USDA government program to help improve nutritional disparities of low-income women and children and to provide referrals to other agencies.

Background/Significance

The Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) was established as a pilot program in 1972 (USDA, 2012a) and authorized by congress in 1974 (Siega-Riz et al., 2004). The purpose of WIC is to help lessen the health disparities seen in women, infants, and children. Health disparities refer to differences in health status of different groups of people based on race, ethnicity, or region. WIC serves low-income pregnant, post-partum women (length of time depends on breastfeeding status), infants, and children aged 1-5 years who are at nutritional risk as determined by nutrition assessment based on federal guidelines. The initial funding level for WIC in 1974 was $20.6 million. The program was expanded nationally in 1990. In the 2012 fiscal year funding for WIC was $6.618 billion (Siega-Riz et al., 2004; USDA, 2012b). Marion County WIC's caseload is 34,000. In 2014, the most recent year for which data is available, the State of Indiana spent $110 million on WIC (ISDH 2014).

Overweight and obesity are global health concerns increasingly affecting children as well as adolescents. In the U.S., 37.1% of children aged 2-19 years are overweight with 17% classified as obese according to National Health and Nutrition Examination Survey (NHANES) 2007-2008 data (Spence, Cifelli, & Miller, 2011). The Pediatric Nutrition Surveillance System (PedNSS) is a public health surveillance system that monitors the nutritional status of low-income children in federally funded maternal and child health programs. WIC collected 87.5% of 2010 PedNSS data. As shown in Table A-1, obesity rates have climbed 4% since 2007-2008 when compared to 2009-2010 data.

Determining Weight Status from Growth Charts

Determining if a child is overweight or obese relies on properly defining what overweight and obesity are in children. Maaluf-manasseh et al compared the prevalence of obesity using the World Health Organization (WHO) growth charts and the Centers for Disease Control and Prevention (CDC) growth charts in a Massachusetts WIC population (2011). The study included 143,787 children 2.00-4.99 years of age who collectively had 392,927 WIC visits. Approximately 43% of the children were white/non-Hispanic, 32% Hispanic, 19.2% black, and 5.7% Asian/Hawaiian/Pacific Islander. The prevalence of obesity as assessed by the WHO growth charts was higher than the prevalence estimate using CDC charts (23.3% vs. 16.9%). The difference between the prevalence estimates was larger among younger children. The prevalence estimate of obesity in the 24-27 month age group doubled from 12.6% using CDC charts to 25.3% using WHO charts. However, the accuracy of measurements cannot be assured despite WIC staff receiving training in anthropometric measurements (Maalouf-Manasseh, Metallinos-Katsaras, & Dewey, 2011).

As Ogden (2010), using NHANES 2009-2010 data of 4,111 children and adolescents birth-19 years of age (1,376 non-Hispanic white, 792 non-Hispanic black, and 1,660 Hispanic.), pointed out, children with a high body mass index (BMI) often become obese as adults increasing their risk for cardiovascular disease (CVD), type II diabetes mellitus, and certain cancers. Overweight/obese children may have difficulties making friends due to discrimination, increased risk of respiratory issues, such as asthma, and risk factors for CVD (Nelson, et al, 2006). Sekhobo et al. studying a New York State WIC population examined overweight and obesity trends. The study used sex-specific

BMI of ≥ 85 < 95 percentile for defining overweight and ≥ 95 percentile for defining obesity. The obesity prevalence peaked in 2003 at 16.7% and declined slightly from 2003-2005, stabilizing at 14.7% through 2007. Sekhobo et al also reported that the annual prevalence estimate for overweight had an increasing trend from 2002 to 2007 (Sekhobo, et al., 2010). Many factors play into the rise seen in childhood overweight and obesity.

Sugar Sweetened Beverage Consumption and Obesity

Torre et al. performed a systematic review to analyze the methodology of studies investigating the influence of sugar-sweetened beverage (SSB) consumption on risk of obesity among children and adolescents, and the studies' ability to answer this research question. In selecting studies for the review: studies had to be published in peer-reviewed journal in English or French language; include healthy children and adolescents ≤ 18 year of age of any socioeconomic status and racial/ethnic group regardless of weight status; use one of the following study methodologies: cohort study (follow up of at least 12 months) or intervention study (follow up of at least 4 weeks); address the exposure of interest, which was consumption of beverage with any type of added sugar (fructose, glucose, sucrose, or high-fructose syrup) and exclude studies targeting milk consumption, because other nutrients like protein or lipids may confound results ; address outcome of interest (weight gain, body fat mass, overweight, or obesity); and provide original data.

The authors screened 1,416 studies. Thirty-two studies met selection criteria. The methodological quality of each study was assessed using the Quality Criteria Checklist: Primary Research of the Academy of Nutrition and Dietetics. The content of the checklist is based on the quality constructs and domains identified by the Agency for Healthcare Research and Quality. The checklist includes ten validity questions that address scientific soundness: research question statement, selection bias, group comparability, handling of withdrawals, use of blinding, intervention regimen or exposure factors description, outcomes definition and measurements, statistical analyses, conclusions, and potential funding bias. When taking quality into consideration among the 32 studies analyzed, less than one-third (9 studies) had a positive quality rating, five of which show an association between sugar sweetened beverages consumption and obesity risk and four having mixed results. There were 23 studies that received a neutral quality rating with the methodological issues noted being mostly due to the complexity of assessing and measuring dietary intake. There were seven neutral quality studies that found a positive association, nine with mixed results, and seven with no association.

Effect of Beverage Consumption on Energy Intake

Eating behaviors are learned, primarily from parents, within the first five years of life and serves as a foundation of future eating patterns (Savage, et al., 2007). Beverage consumption by children is of particular interest due its relationship to food intake. Energy intake from sugar sweetened beverages (SSBs) increased 135% between 1977 to 2001 (Han & Powell, 2013; Wang, Bleich, & Gortmaker, 2008).

Wang (2009) estimated the extent to which caloric beverages were linked to higher daily energy intake in a pediatric population. The study population included a total of 3,098 children 2-19 years of age grouped into three categories: Preschool (2-5 years of age; 615 out of total study population), Primary School (6-11 years of age; 733 out of total study population), and High school or Higher (12-19 years of age; 1750 out of total study population). There were 931 non-Hispanic white children, 1,147 non-Hispanic black children, and 1,020 Hispanic children).

Wang performed a secondary analysis utilizing a fixed-effect regression with β-coefficients for within person changes in total energy intake as a function of changes in consumption of each of the five beverage categories using two nonconsecutive 24-hour dietary recalls from NHANES 2003-2004 data. Wang found that each additional serving of sugar-sweetened beverages (defined as soda, sports drinks, fruit drinks, punches, low-calorie drinks, sweetened teas, and other sweetened beverages) corresponded to a net increase of 106 kcal/day (95% CI, P value < .001). Wang held all other beverages constant in the fully adjusted model (controlled for intake of other beverages, intake of non-beverage items, and effects of weekends and fast food intake). This means that if 8oz of SSB is consumed, the total energy intake is increased and there is no evidence that other food intake is reduced to compensate for the extra energy intake from beverages. Other beverage categories whose intake was significant were whole milk (net increase of 169 kcal/day), 2% milk (net increase of 145kcal/day), and 100% juice (net increase of 123kcal/day) (CIs 95%, P values < .001) (Wang 2009).

Exactly what children consume depends heavily on what caregivers/parents provide as beverages. McElligot et al. surveyed parents concerning their children, ages 1-5 years, beverage intake. The study population consisted of those who utilized WIC services in South Carolina and those who did not. The objective was to evaluate consumption patterns and parental perceptions regarding fruit juice. Of the 173 who returned surveys, 51% received WIC. Frequencies were calculated for each variable and results were dichotomized so children were classified as: low consumers (≤ two servings per day) and high consumers (≥ three servings per day). Comparisons were made between high and low juice consumers and WIC and non-WIC participants using chi-square and Wilcoxon rank sum tests. Children who consumed more milk were less likely to be high consumers of juice (13% versus 33%, $P < 0.05$ chi-square). Two-thirds of parents surveyed reported introducing juice before their child reached 12 months. This behavior occurred more frequently in WIC families (78%) than non-WIC families (54%) (McElligott et al., 2012).

Marshall et al looked at consumption of dairy foods, 100% juice, and sugar-sweetened beverage intake by surveying participants in the Iowa Fluoride Study annually from 1-5 years of age using three-day food/beverage diaries and performed cross-sectional analyses of all the data collected. The main study objective was to determine the contribution of dairy food to diet quality and the effects of beverages on diet quality in children. The study included 645 children where ninety-eight percent of the mothers were Caucasian. Household income for 65.2% of parents whose children were part of the study was below $50,000. Over half of the mothers (80.5%) and fathers (66.5%) were under thirty-five years of age. Spearman correlation coefficients were used to identify associations between dairy foods and beverage intakes. General linear regression models were used to describe the relationships among milk, other dairy foods, 100% juice, and sugar-sweetened beverages. The results showed that milk intake was inversely associated with the intake of juice drinks ($r = -0.14$, $p < 0.01$), soda ($r = -0.15$, $p < 0.001$), and other sugar-sweetened beverages ($r = -0.19$, $p < 0.001$). Overall diet quality was predicted by increased energy intake, increased other dairy intake, decreased 100% juice, and decreased sugar-sweetened beverage intakes. The study concluded that the intake of milk and other dairy products was associated with adequate intakes of multiple nutrients, including calcium and vitamin D (Marshall, Eichenberger Gilmore, Broffitt, Stumbo, & Levy, 2005).

Beverage Intake and Risk for Obesity

Nelson et al administered a one page survey to the parents of 526 children 2-4 years of age enrolled in WIC in New York. The survey asked questions about their children's food and beverage consumption, television viewing, computer time, and physical activity. The results found that 58% of children consumed more than one 8oz serving of fruit drink (non-100% juice)/day and 30% consumed more than two 8oz servings of fruit drink (non-100% juice)/day. The children who consumed more than one serving of nonjuice fruit drink/day (the 30%) had an increased odds ratio (1.57 OR (1.03-2.40), 95% CI) of being overweight or at risk of being overweight. Almost 40% of children were overweight or at risk of being overweight. Hispanic and white children were twice as likely as black children to have a BMI at or higher than the 85%. The study also found that consumption of soda and snack foods increased with age; at two years of age, 44% of children consumed at least one unhealthy snack or soda every day which increased to 57% of the children by four years of age (Nelson et al., 2006).

Kral et al completed a prospective assessment of beverage consumption in children 3-6 years of age at different risks for obesity and determined the relationship to weight status using three-day food records. Beverage intake was coded in seven categories (milk, fruit juice, fruit drinks, caloric soda, noncaloric soda, soft drinks with and without fruit juice). The study found that children at the highest risk for obesity consumed a greater percentage of daily energy intake from beverages at three ($p < 0.05$) years of age, more fruit juice at ages three and four, more soft drinks (including fruit juice) at 3-5 years of age ($p < 0.05$), and more soda at six years of age ($p < 0.05$) than children at low risk for obesity. However water intake was not recorded and all the beverage intakes were averaged across the number of days of food records for each child (Kral et al., 2008).

Water Intake in Children

Water, as a separate beverage, seems to make up a relatively small amount of total beverage intake. Kant et al. looked at water intake of 3,978 children 2-19 years of age using NHANES 2005-2006 data. There were 866 children 2-5 years of age, 1,004 children 6-11 years of age, and 1,997 children 12-19 years of age. The analysis was limited to the 2005-2006 survey because methods to collect plain water information in surveys conducted from 1999 to 2004 differed. In the 2005-2006 survey the water intake (plain or carbonated) questions were integrated within the automated multiple pass method used for collecting the 24-hour recall; in the surveys from 1999 to 2004 respondents were asked "How much plain water did you drink yesterday?" Six different types of water variables were examined from the 24-hour recalls: intake of plain water, moisture in foods, moisture in all beverages, moisture in nutritive beverages, total water intake, and total water intake/kcal of reported energy intake. Potential covariates examined included: sex, race/ethnicity (non-Hispanic white, non-Hispanic black, Mexican American, and other), age category (2-5, 6-11, 12-19 years of age), weekday of dietary intake recall, body mass index for age-specific percentile category, hours of screen time (television, computer, other electronic devices), reported level of physical activity, and season in which the exam was conducted. Recall was provided by parents of children 2-5 years of age. Kant et al. found that the highest percentage of 24-hour total water intake from beverages was reported for children 2-5 years of age (52% of total water intake), but nearly 70% of the water consumed in 24 hours came from nutritive beverages and 22% from plain water. Children 2-5 years of age consumed 1,376g of water from all sources and 302g came from plain water. (Kant & Graubard, 2010).

Beverage Intake in WIC Populations and Weight Status

The association of beverage intake and body weight in children is not a consistent finding. Newby et al in a prospective examination of 1,345 children 2-5 years of age that were enrolled in a North Dakota WIC program found no significant association between weight change and beverage intake. Majority of the study population was Caucasian or Native American for both girls and boys (95% for each). The study divided beverages using the categories fruit juice, fruit drinks, milk, soda, and diet soda. The study controlled for age, gender and any changes in weight and BMI using a multivariate regression analysis adjusted for age, sex, energy intake, changes in height, and additional sociodemographic variables. The study found that weight change was not significantly associated with consumption (per oz) of any of the beverage categories; in other words, there was no association between the beverage categories and changes in weight or BMI in the North Dakota WIC population (Newby et al., 2004).

In contrast, using a prospective cohort design Faith et al surveyed the parents/guardians of 2,801 children ages 1-4 who attended 1 of 49 WIC agencies in New York State in 1999 or 2000. The survey addressed dietary intake, parental feeding practices, and parental exposure to nutritional counseling messages. The investigators hypothesized that increased fruit juice consumption and eating restrictions would be associated with an increase in adiposity. They also considered whether or not nutritional counseling predicted a reduction in adiposity in children. Faith et al found that among children who were either at risk for overweight or were overweight, increased 100% juice consumption was associated with excess adiposity gain ($p < 0.01$); whereas parental offerings of whole fruits were associated with a reduction of adiposity (Faith, Dennison, Edmunds, & Stratton, 2006) which could be related with the increase in fiber intake and increased satiety.

Welsh conducted a retrospective cohort of 10,904 (88.6% white, 5.8% black, and 5.6% other) preschool kids ages 2-3 in the Missouri WIC program and examined the association between sugar-sweetened beverage consumption and overweight. Data were collected for the Missouri Pediatric Nutrition Surveillance System (PedNSS) and the Missouri Demonstration Project through WIC. PedNSS utilized height and weight measurements and the Demonstration Project utilized the Harvard Service Food Frequency Questionnaire (HFFQ) for dietary intake. The HFFQ was originally developed to assess the diets of low income women and was subsequently modified for the Welsh study. The data were collected between January 1999 and December 2001. The study's outcome variable, overweight, was defined as a BMI as $\geq 95^{th}$ percentile for age and gender per CDC growth charts. At baseline: 75.5% were normal or underweight, 14.5% were at risk of being overweight, and 10.1% were overweight; while at the study's follow-up: 3.1% of the children at baseline who were normal or underweight were found to be overweight, 25% of children at risk of being overweight at baseline were overweight, and 67% of children who were overweight at baseline remained overweight at follow-up one year later (11-13 months). The mean total energy intake was calculated to be 1780kcals/day. As shown in Table A-2, children who were at risk for being overweight at baseline were more likely at follow-up to be overweight and children who were overweight at baseline were more likely to remain overweight at follow up (Welsh et al., 2005).

Socioeconomic Level and Sugar-Sweetened Beverage Consumption

Children within a low socioeconomic population are more likely to consume more sugar-sweetened beverage and fruit drinks. Han and Powell analyzed consumption patterns and individual-level associations using trend and cross-sectional analyses of 24-hours dietary recall data, sociodemographic characteristics, and socioeconomic status from NHANES (1999-2000, 2001-2002, 2003-2004, 2005-2006, and 2007-2008). The participants were children 2-11 year of age (N = 8,627), adolescents 12-19 years of age (N = 8,922), young adults 20-34 year of age (N = 5,933), and middle-aged adults and elderly $\geq$ 35 years of age (N =16,456). Han and Powell reported that black children and adolescents showed higher odds of heavy fruit drink consumption (odds ratio (OR) 1.71 and 1.67 respectively) than whites. Children from low-income families generally had a higher odds of heavy total SSB consumption (OR 1.93) and higher energy intake from total SSB (by 23kcals/day) and fruit drinks (by 27kcals/day) than children from higher income families (Han & Powell, 2013).

Sugar-Sweetened Beverage Consumption and BMI status

Skinner and Carruth using a longitudinal study of 72 (37 boys, 35 girls) Caucasian children 2-6 years of age in the vicinity of a southern US city. Seven in home interviews were conducted per child when each child was between 24 and 72 months of age. The families were either middle or upper socioeconomic status and all parents except for one mother had some education beyond high school. The interviews were conducted by one of two registered dietitian. The first two interviews used in the study were randomly assigned by a computer generated program when children were 24, 28, or 32 months of age and 28, 32, or 36 months of age; all children were interviewed at 42, 48, 54, 60, and 72 months of age. The researchers found no statistical significance in associations between juice consumption and children's height, weight, or BMI as tested by linear models. Skinner and Carruth surmised that the longitudinal 100% juice intake of children was not associated with either short stature or overweight in children (Skinner and Carruth, 2001).

Lim et al. used data from the Detroit Dental Health Project Study to look at the association between consumption of SSB and obesity in a cohort of 365 low-income African American children 3-5 years of age. The 2 year longitudinal Detroit Dental Health Project cohort utilized the Block Kids Food Frequency Questionnaire and addressed: the relationship between SSB consumption and BMI, changes in consumption of SSB and change in BMI over 2 year period, and factors that are related to the incidence of occurrences of new cases of overweight children. The prevalence of overweight in the time between baseline and follow-up increased from 12.9% to 18.7% and the prevalence of obesity nearly doubled. Incidence of overweight occurred in 26.3% of baseline nonoverweight and the incidence of obesity occurred in 13.4% of baseline nonobese children. Soda consumption was 6.1oz/day at baseline and decreased slightly to 5.2oz/day. Fruit increased from 13oz/day at baseline to 16.5oz/day at follow-up and total SSB intake increased from 19.2oz/day at baseline to 21.6oz/day at follow-up throughout the conclusion of the study. Total daily energy intake at baseline was 2,243.3 kilocalories and at follow up it was increased to 2,565.3 kilocalories. Lim found that the odds of becoming overweight increased by 1.04oz of SSBs consumed per day. The study also estimated that children were getting 260 kcals from low nutrient dense foods and beverages and 65g of sugar from the ~20oz of all sugar-sweetened beverages consumed daily (Lim et al., 2009).

DeBoer et al. assessed SSB consumption and BMI among children 2-5 years of age followed in the Early Childhood Longitudinal Survey- Birth Cohort (ECLS-B). The ECLS-B is a large multi-source, multi-method study sponsored by the National Center for Education Statistics (NCES), US Department of Education. The ECLS-B was designed to examine a large range of influences on early childhood experiences. The cohort includes a nationally representative sample of children born in 2001 and who were selected based on random sampling of > 14,000 birth certificates and a final sample of 10,700 completed parent interviews. Parents were interviewed at infant's birth then examined longitudinally at ages nine months, two, four, and five years. Parents of children ages two, four, and five were instructed that sugar-sweetened beverages were clarified as "soda pop, sports drinks, or fruit drinks not 100% juice. Specifically at the two year visit parents were asked separate questions regarding whether the child usually drinks SSB with meal and with snacks. If either question was answered yes the child was categorized as a regular SSB drinker. At the four year visit parents were asked separate questions on how many times their child drank SSB; categories for frequency included: no intake in past seven days, 1-3 times in past seven days, 4-6 times in past seven days, once daily, twice daily, three times daily, $\geq$ 4 times daily. Children at ages two, four and five were categorized as either regular drinkers ($\geq$ 1 SSB serving daily) or infrequent/nondrinkers (< 1 SSB serving daily). All statistical significance tests were two-sided with a significance level of $\alpha = .05$. In evaluating longitudinal changes in BMI z score, the baseline SSB intake status was used to minimize reverse causality and all cross-sectional multivariate models were adjusted for gender, race, and sociodemographic status (DeBoer, 2013).

DeBoer found that at two years of age there was no association between SSB consumption and higher BMI. The authors used logistic regression when looking at SSB intake per year of age on obesity status by year of age. Regular drinkers of SSB at four and five years of age compared to their infrequent/nondrinkers of SSB counterparts had a higher odds of being overweight and obese in an unadjusted logistic regression analysis (has dichotomous outcome); however at four year of age those associations were not present after adjustment for potential confounders, but by five years of age the regular SSB drinkers had a higher odds of obesity. Linear regression (outcome is continuous) was used to show that increasing the quantity of SSB was associated with higher BMI z scores at four and five years of age, both before and after adjustment for multiple potential confounders. Compared with nondrinkers/infrequent drinkers, children drinking $\geq$ 1 SSB at two years of age had a greater increase in BMI z score by four years of age ($P < 0.05$). Daily SSB consumers at four years of age had a similar change in their BMI z score between four and five years of age compared to nondrinkers/infrequent drinkers of SSB. The study contained several limitations: SSB consumption quantity was based on parental report and not direct observation of intake; no complete dietary information was available preventing assessment of SSB intake on overall energy intake; nor did they have data on physical activity to address potential compensation in energy expenditure (DeBoer, 2013).

Milk Consumption and Weight Status

Scharf et al. using the ECLS-B Cohort study evaluated relationships between the type of milk consumed and weight status among preschool children. All statistical significance tests were two-sided with significance of $\alpha = .05$. To assess longitudinal associations of milk type with weight gain over time the authors selected children reported to drink 1% or skim (grouped together) at both two and four years of age and those reported to drink 2% or whole milk (high fat) (grouped together) at both time points allowing for the purest contrast between milk type and BMI change. Overweight/obesity was highly prevalent at both time points (30.1% at two years of age and 32.2% at four years of age). The prevalence of 1% and skim milk consumption was higher among overweight/obese children (14% at two years of age, 16% at four years of age) than among normal weight children (9% at two years of age and 13% at four years of age, $p < .01$ at both years). Mean BMI z scores varied significantly across milk type with lower mean BMI z score among 2% and whole milk drinkers compared to 1% and skim milk drinkers; these patterns were consistent with at both two and four years of age and among race/ethnic subgroups. Similarly, linear regression revealed that consumption of higher fat milk was associated with lower BMI z-score, including after multivariate adjustment for sex, race/ethnic, SES, intake of juice, and SSB, and maternal BMI. The authors found that children who consistently consumed 1%/skim milk at both the two year and four year time points had higher BMI z scores at both evaluations than those drinking 2%/whole milk.

Linear regression analysis adjusted for sex, race/ethnicity and SES, showed no significant difference between the low-fat milk group and the high fat milk group BMI z-score; however consistent 1% and skim milk consumers (drinking same milk type throughout both time points) who were not overweight/obese at baseline were more likely in a regression model adjusted for baseline BMI to become overweight/obese between two and four years of age (OR 1.57, 95% CI 1.03 to 2.42) versus consistent whole and 2% milk consumers (drinking same milk type throughout both time points). The authors noted that their analysis may not have accounted for residual confounding factors that could have contributed to consistent 1%/skim milk drinkers' higher OR for becoming overweight/obese.

Scharf et al. did discuss the logic for high-fat milk stating: "theoretically high-fat milk intake may result in less weight gain if consumption leads to an overall decrease in calories consumed." This can be partly due to fat's satiety effect. Utilizing a secondary analysis of data from the ECLS-B using measures that were not themselves primary outcome measures was a notable weakness of the Scharf study. . As with the study conducted by DeBoer et al. the data lacked other forms of food intake. The sample size was a strength due to the fact that it was a large, nationally representative database (Scharf 2013).

Lu et al. performed a meta-analysis of ten studies comprising 46,011 children and adolescents with an average follow-up of three years to examine the longitudinal association between dairy consumption and the risk of overweight/obesity in children and adolescents. The authors pooled associations of dairy consumption with risk of overweight/obesity, percent of body fat, and BMI gain, respectively using a random-effects model. Heterogeneity for each pooled analysis was evaluated by Cochran's Q test and I^2 statistic. Low, moderate, and high degrees of heterogeneity were corresponding to

I^2 values of twenty-five, fifty, and seventy-five percent. Publication bias was assessed using both Egger's and Begg's tests; if bias was suggested, Duval and Tweedie nonparametric "trim and fill" method to give an adjusted estimate of the pooled association. Sensitivity analyses were conducted to evaluate the effect of removing any single study from the meta-analysis and the robustness of the results by replacing random-effects models with fixed-effects models. A two-sided P-value ≤ 0.05 was considered statistically significant (Lu, 2016).

The pooled association between dairy consumption and risk of overweight/obesity was estimated based on four prospective cohort studies that included a total of 22,205 participants. Lu et al. found that as compared with those who were in the lowest intake group of dairy products, children in the highest intake group were 38% less likely to have overweight/obesity (pooled OR = 0.62; 95% CI: 0.49-0.80). To determine the possible dose-response relationship they standardized dairy consumption to number of servings per day. The risk of childhood overweight/obesity was 13% lower with one serving/day increment in dairy intake (pooled OR = 0.87, (0.76-0.98) (Lu, 2016). The authors did not investigate types of dairy products (such as high fat milk versus low fat milk) in the relation to the risk of overweight/obesity in children and adolescents.

Juice Consumption and Weight Status

Nicklas performed a secondary analysis of 1999-2002 NHANES data utilizing a cross-sectional study to investigate four categories of 100% juice consumption (0 fluid oz (fl.oz.), $> 0 \leq 6$ fl.oz., $> 6 \leq 12$ fl.oz., and ≥ 12 fl.oz.) in 3,618 children 2-11 years of age utilizing 24-hour recall. Children were grouped into one of 3 age groups: 2-3 years of age, 4-8 years of age, or 9-11 years of age. Out of the children: 51% were male, 33%

Hispanic, 29% white, 29% black, and 9% other race. On day of the 24-hour recall, 43% of children consumed 100% juice (55% in the 2-3 year old children group, 41% in the 4-8 year old children group, and 35% in the 9-11 year old children group).

The study found that 100% juice consumers, compared to their nonconsumer peers, had significantly higher intakes of energy, carbohydrates, vitamin C, vitamin B_6, potassium, riboflavin, magnesium, iron, and folate, and lower intakes of total fat, saturated fatty acids, discretionary fat (defined by the authors as amounts of fat far above that consumed if the lowest fat choices were made in all food groups), and added sugar.

The mean for 100% juice consumption was 4.1 fl.oz./day with a mean energy intake of 58 kcals overall for all groups; the highest mean 100% juice consumption was in the 2-3 year old children group who consumed 6 fl.oz. of 100% juice/day. There were no significant differences found in weight status and amount of 100% juice consumed. On average children consumed less 100% juice than what is recommended by the American Pediatric Association. 100% juice intake was not associated with weight status or likelihood of being overweight in children 2-11 years of age (Nicklas Ta, 2008).

Sugar-Sweetened Beverage Intake and Nutrient Intake

Keller et al conducted a cross-sectional study using data previously collected on a twin (same-sex and fraternal) cohort of 126 children (54 boys and 72 girls) 3-7 years of age designed to test genetic and environmental influences on child eating behaviors and body composition. Keller et al. hypothesized that increasing SSB intake was associated with decreasing milk and calcium intake in a laboratory-based meal. For all tests $P \leq 0.05$ was the cut off for significance, and all hypotheses were two-tailed. Descriptive statistics (means and standard deviations) were generated for quantitative data, including beverage parameters (i.e. energy from SSBs and milk, as well as total energy, macronutrients, and micronutrients (calcium and vitamin D)). Pearson correlation coefficients were calculated to test that SSB intake was negatively associated with intake of milk, calcium and vitamin D; these analyses were performed after adjusting for key descriptive variables (i.e. age, sex, and ethnicity) (Keller, Kirzner, Pietrobelli, St-Onge, & Faith, 2009).

The study found that SSB (soft drinks, juice, and juice drink) was negatively associated with the consumption of milk ($r = -0.22$, $P < 0.01$) as well as calcium ($r = -0.24$, $P < 0.01$) and vitamin D ($r = -0.28$, $P < 0.05$). However, maternal beverage consumption patterns may have influenced the child's choice (parent was allowed to eat with child) and was not factored in and the lab meal; thus, it may not best reflect a child's true habitual intake since it is not in his or her usual environment (Keller, Kirzner, Pietrobelli, St-Onge, & Faith, 2009).

Nickelson and others used cross-sectional data from parents of 71 children ≤ 5 years of age (36.6% < 1 year of age, 40.8% 1-2 years of age, and 22.5% 3-5 years of age) recruited from Child Development Research Center (CDRC) at the University of Alabama (Tuscaloosa) and two local offices of the Special Supplemental Food Program for Women, Infants and Children during 2009-2010. Ethnicity of the children's parents was 52.1% African-American/Black and 47.9% Caucasian white with 22.6% of the parent's education being high school grad/GED or less than high school.

Elements of the Health Belief Model and Theory of Reasoned Action facilitated data analysis and interpretation. Five dichotomous SSB intake variables were created from participants' responses to 10 beverage items. Parents were asked how often their child drank each beverage, scored on a scale of 0 to 3: 0, never (drinking the beverage);

1 or 2, rarely (drinking the beverage ≤ once weekly, but not daily); 3, regularly (drinking the beverage ≥ once daily). Three SSB categories were created by summing up the scores for each individual beverage within the category. Categories included: fruit drinks (non-100% juice), sodas ("soft" drinks), and sweetened milk (flavored milk, milkshakes).

The authors found that the most consistent predictor of SSB intake was child age. Children 3-5 years of age, nearly 94% consumed sweetened milk products, 88% consumed fruit drinks, 63% soda, and 56% consumed sport drinks and sweet tea, as reported by parents and caregivers. The results suggest that more SSBs are consumed as children become older. The study was limited by its sample size and convenience approach, self-reported nature of the items, and age of the children examined in the study (Nickelson 2014).

In Québec, Canada, Dubois et al studied a representative sample of 2,103 (at baseline, 1,944 remained at data collection at 4-5 years of age) children 2-4.5 year of age born in 1998 to determine the relationship between the consumption of SSBs (defined as any drink with added sugar) between meals and the prevalence of children being overweight. Dubois et al utilized the Longitudinal Study of Child Development in Québec (1998-2002) which collected data at ages 2.5, 3.5, and 4.5 years from 2000-2003. The main objective of the Longitudinal Study of Child Development in Quebec was to analyze the role or familial and social factors in children's health and cognitive and behavioral development (Dubois, 2007).

Before the analysis, data were weighted by a factor based on: the inverse of the selection probability, probability of nonresponse, post stratification rate, and the attrition rate, to ensure data were longitudinally representative of the same-age children in the population. From the 1,549 children participating in the nutrition study, 1,499 (97% of the sample) were part of the analysis. Data were treated both as cross-sectionally and longitudinally. First as cross-sectionally at 2.5, 3.5, and 4.5 years of age for an exploratory analysis of the SSB consumption at each year of age. From those analyses, two longitudinal indicators were created: regular consumers and daily consumers. Longitudinal analyses examined SSB over time from 2.5 to 4.5 year of age and cross sectional analyses examined overall consumption with body weight at 4.5 years of age (Dubois, Farmer, Girard, & Peterson, 2007).

Dubois et al. defined sugar-sweetened beverage as a drink that has added sugar, consisting of regular or non-diet carbonated drinks and fruit flavored drinks. 100% juices were excluded from the Food Frequency Questionnaire (FFQ) because they provide nutritional value beyond the energy provided by beverages with added sugars. A self-administered FFQ was completed by the children's mothers when children were ages 2.5, 3.5, and 4.5. At age 4.5 a 24-hour recall was also conducted. Dubois et al found that 6.9% of non-SSB consumers were overweight versus 15.4% of regular SSB consumers for ages 2.5-4.5. They concluded that SSB intake between meals from ages 2.5 to 4.5 more than doubles the odds (OR 2.4, CI 95%) of being overweight even when other factors are considered using a multivariate analysis (Dubois, Farmer, Girard, & Peterson, 2007).

NHANES and Beverage Consumption Patterns

Secondary analysis evaluating beverage trends in American youth primarily used NHANES data. One such analysis evaluated intake among preschool children using NHANES 1999-2002 and looked at associations between the type and quantity of a beverage consumed and the weight status of children. The review categorized beverages as: 100% fruit juice, fruit drinks, milk subcategorized by fat content, sweetened soft drinks, and diet drinks. The review found that: 83% of children consumed milk (46.5% drinking whole, 3.1% skim, and 5.5% 1% milk), 44% consumed fruit drinks, 48% consumed 100% fruit juice, and 39% consumed soda. There was no clinical significance between type of milk consumed and weight status. Weight status was not associated with the amount of total beverages consumed (O'Connor, Yang, & Nicklas, 2006).

Fulgoni and Quann performed an analysis looking at birth to 5 years of age using multiple NHANES data sets (1976-80, 1988-1994, 2001-2006). In the data sets for 1976-80 and 1988-1994, 84-85% of children were drinking milk compared to only 77% of children from NHANES 2001-2006. Fruit juice intake was more than 50% in the 2001-2006 versus only 30% in the older surveys. However, there were no significant changes observed for fruit drink consumption across all three surveys; consumption, on average, was found to be 35-37% of population. It was also evident from the NHANES data that a greater percentage of children consumed soft drinks with increasing age and looking at the 2001-2006 survey 19% of children consumed soft drinks at one year of age, 29% at two years of age, 38% at three years of age, 41% at four years of age, and 45% by five years of age (Fulgoni & Quann, 2012).

Wang found that data from NHANES 1999-2004 years showed that children aged 2-5 years children consumed on average 176kcals from SSBs and that on average fruit juice consumers took in 148kcals (Wang et al., 2008).

Slinging et al. examined cross-sectional data on 2- to 18-year olds from six nationally representative surveys of food intake in the United States: the Continuing Survey of Food Intakes by Individuals (CSFII) of 1989-1991, 1994-1996, 1998 and

NHANES 2003-2004, 2005-2006, 2007-2008, and 2009-2010. Dietary intake for CSFII 1989-1991 was collected on three consecutive days using an interviewer-administered one-day dietary recall and a self-administered two-day dietary record with help from the main meal planner/preparer in the household.

CSFII 1994-1996 and 1998 dietary intake were collected using interviewer-administered one-day dietary recalls on two nonconsecutive days. The one-day recall was modified to include multiple passes through the list of all foods and beverages. As with CSFII 1989-1991, the main meal planner/preparer reported for children younger than 12 years.

The authors used food and beverage groups originating with nine USDA food groupings. Food, groups were systematically disaggregated based on nutrient composition, critical dietary behaviors, and similarities in consumption patterns. A total of 41 food groups and 12 beverages groups were created. The beverage groups were as follows: water (plain or flavored), coffee/tea, SSB, fruit juice, vegetable juice, full-fat milk, non-fat milk, milk/yogurt/soy drinks, meal replacement beverages, sports drinks, energy drinks, alcoholic beverages.

The study found that per capita intakes of nonfat milk, quick breads, and sandwiches increased from 1989-2010. These findings are similar to other studies examining the sources of intake among US children and adolescents from the late 1960s through the early 2000s which show increased intakes of nonfat milks, sweet snacks, and candies and decreased intakes of full-fat milk, breads, and meats through early 2003-2004. Collecting reliable and accurate dietary data remains difficult due to limitations of dietary assessment methods and the potential for underreporting intakes by caregivers.

In summary there is a lack of consensus regarding the relationship between beverage intake and weight gain in children. Faith et al found a significance between beverage intake and adiposity gain in children in a New York WIC population, whereas Newby et al found no significance between beverage intake and weight gain in a North Dakota WIC population. Nelson et al used a New York WIC population and found increased odds ratio for children becoming overweight or obese with how much fruit juice was consumed daily. McElligott used a South Carolina WIC population (51% were receiving WIC benefits) examined consumption patterns in children and their parent's perception of juice consumption and found that WIC parents more often than non-WIC parents thought juice was as healthy as fresh fruit (56% compared to 9%; $p < 0.01$). Welsh et al, utilizing a retrospective cohort, found that reducing SSB intake in children could help manage weight gain in children in a Missouri WIC population.

No matter where in the United States people live, the increasing incidence of overweight and obesity in children is very alarming. Today there are clearly more beverage options for children than in the past. Understanding regional consumption patterns and beliefs associated with beverage consumption will help health professional obtain specific data that will allow nutrition education to target the needs of the population they serve. The purpose of this specific location related study is to determine if there is a relationship between beverage consumption and incidence of overweight/obesity in a selected population of WIC children in central Indiana.

Methodology

This study was approved by the IUPUI Institutional Review Board (IRB) and the Marion County Research Review Board. Participants were parents of children, ages 2-4 years, with scheduled WIC appointments at the West 38th Street or National Square clinics. A total of 30 surveys were completed for this study. Parents were invited to participate in the survey. A consent form was presented to parents explaining the purpose of the study and any risks associated with participation. Sociodemographic information, such as age of child, race/ethnicity, parent's educational level, and household income, was noted.

Beverage Intake

Each child's beverage intake was assessed using a food frequency questionnaire (FFQ) (Table 3).The FFQ was administered along with a consent form by the study investigator. Parents were asked the frequency of one cup (8 fluid ounces) servings for each category. A food model was used to help parents visualize what a one cup serving was. Any questions participating parents had concerning the FFQ was answered by the study investigator.

The FFQ (Table 3) was a modified version of the Center for Disease and Control Prevention 2003-2004 NHANES FFQ (questions of the original FFQ can be found at: http://www.cdc.gov/nchs/nhanes/nhanes2003-2004/FFQRAW_C.htm#FFQ0001). For purposes of analysis, beverages were grouped into seven categories: milk, 100% juice, fruit drinks (non-100% juice), nutritional supplements, sports drinks, tea, and soft drinks. Frequency of consumption was: Never, 1x/month or less, 1-2x/week, 3-4x/week, 5-6x/week, 1x/day, 2-3x/day, 4-5x/day, or 6 or more times/day.

Table 3: Food Frequency Questionnaire

Beverage Intake in an Indianapolis WIC Population

Demographics (Circle Answer)
Age of child (in years): 2 3 4

Child's Race/Ethnicity: _________________________

Parent's Highest Level of Education:
Eighth Grade or Below High school (Specify year: freshman/sophomore/junior/senior)

GED 2 year College Degree 4 year College Degree Vocational School

Household Income:
$20,000 or below $20,000-$30,000 $30,000-$40,000 $40,000-$50,000

$50,000 or above

Household Size: _______

Food Frequency Key
Never = 0 **1 time or less/month** = 1 **1-2 times/week** = 2 **3-4 times/week** = 3

5-6 times/week = 4 **1 time/day** = 5 **2-3 times/day** = 6 **4-5 times/day** = 7

6 or more times/day = 8

Questions (Circle your answers using the food frequency key)

1) How often does your child drink 1 cup (8 fluid ounces) of 100% juice (apple, grape, cranberry, orange, prune, etc.) per day? 0 1 2 3 4 5 6 7 8

2) How often does your child drink 1 cup (8 fluid ounces) of fruit drink (examples: Hi-C, Capri Sun, Sunny -D, Hawaiian Punch, Kool-aid, etc.) per day? 0 1 2 3 4 5 6 7 8

3) How often does your child drink 1 cup (8 fluid ounces) of milk per day? 0 1 2 3 4 5 6 7 8

4) What type of milk does your child drink?

Whole milk (red cap)   2% milk (blue cap)   1% milk (cap color varies)

Skim milk (pink cap)   Lactose Free Whole milk   Lactose Free Reduced/Low-Fat milk

Unflavored (Original) Soy milk   Flavored Soy milk   Light Soy milk

Almond milk   Flavored Almond milk   Light Almond milk

Rice milk   Other:____________________

5) Of the milk your child drinks how often is it flavored (added syrups and pre-made chocolate milk)? 0 1 2 3 4 5 6 7 8

6) How often does your child drink nutritional supplements (one container/bottle) (Kids Boost, Pediasure) per day? 0 1 2 3 4 5 6 7 8

7) How often does your child drink sweetened (regular) soft drinks (soda) per day?
0 1 2 3 4 5 6 7 8

8) How often does your child drink sports drinks (Powerade, Gatorade, etc.) per day?
0 1 2 3 4 5 6 7 8

9) How often does your child drink 1 cup (8 fluid ounces) sweetened tea per day?
0 1 2 3 4 5 6 7 8

For RD to fill out:

Child’s Height: ________

Child’s Weight: ________

Child’s BMI%: __________

Energy Consumption Estimations

Total energy consumption from beverages was calculated based on FFQ responses. Average energy was estimated for one cup for each beverage category. Refer to Table 4 for beverages used in estimating kilocalorie averages used for each beverage category.

Development of Beverage Energy Estimates

The kilocalorie estimates for each beverage category were developed as described below.

Dairy (Milk) Beverages (WIC Supported)

Regular cow milk types (whole, 2%, 1%, and non-fat/skim) are uniform enough across brands that set energy values can be used for each type: 150 kilocalories(kcals) for whole milk, 120 kcals for 2% milk, 100 kcals for 1% milk, and 80 kcals for non-fat/skim milk.

Non-Dairy (Milk Substitute) Beverages (Unflavored Soy is WIC Supported)

Silk and 8th Continent soy milk brands were estimated using kcal averages. Unflavored (original) soy milk is 85 kcals, flavored soy milk is 100 kcals, and light soy milk (flavored and unflavored) is 72.5 kcals.

100% Juice (WIC Supported)

When estimating energy content of 8oz of 100% juice, an average was calculated from orange juice, apple juice, grape juice, cranberry juice, etc. Light juices were excluded from the calculation.

Fruit Drinks (non-100% juice, $\leq$ 10% fruit juice)

Brands used for estimating kcals in 8oz of fruit drinks: Sunny-D, Kool-Aid, CapriSun, Tang, and Hawaiian Punch.

Sports Drinks

The energy level found in both Gatorade and Powerade was 80kcals per 12 ounces of fluid. The food frequency questionnaire inquired about one cup servings so kilocalories were adjusted for sports drinks to reflect the correct serving size.

For Powerade and Gatorade: (80kcals/12oz)/8oz = 53kcals/8oz

Nutritional Supplements (WIC Supported)

Four flavors of Pediasure were used (strawberry, chocolate, vanilla, banana) and two flavors for Kids Boost Essentials were used (chocolate, vanilla). Pediasure containers were 8oz. Kids Boost Essentials were 8.25oz containers and the kilocalories for the Kids Boost Essentials were adjusted to reflect 8oz serving size. . Accounting for the 0.25oz in size difference:

(240/8.25)*8 = 232.72, thus rounding the energy content to 233kcals/8oz for the Kids Boost

Soft Drinks (Soda)

Using 12oz cans the kcals of each respected brand was adjusted for an 8oz serving size.

Calculations for energy in 8oz were as follows:

(170kcals*8oz)/12oz = 113.33 or 113kcals

(160kcals*8oz)/12oz = 106.67 or 107kcals

(150kcals*8oz)/12oz = 100kcals

(140kcals*8oz)/12oz = 93.33 or 93kcals

(120kcals*8oz)/12oz = 80kcals

Tea

Tea poses some difficulty in estimating energy as tea can be brewed unsweetened and sweetened ad-lib to one's desire. Pre-sweetened tea brands were used as a benchmark for kilocalories in tea. Kilocalories for most brands were adjusted for 8oz serving size.

(170kcals*8oz)/16.9oz = 80 kcals

(160kcals*8oz)/18.5oz = 69 kcals

(170kcals*8oz)/12oz = 113 kcals

(100kcals*8oz)/12oz = 67 kcals

(110kcals*8oz)/12oz = 73 kcals

Table 4: Energy Consumption Estimation

Energy Consumption Estimation		
Beverage Category	**Type or Brand**	**Kilocalories (per 8oz serving)**
Dairy	Whole	150
	2%	120
	1%	100
	Skim (Fat Free)	80
Non-Dairy	Unflavored Soy (Silk & 8th Continental)	85
	Flavored Soy (Silk & 8th Continental)	100
	Light Soy (Silk & 8th Continental)	73
100% Juice	Generic Grape (Meijer)	160
	Generic Apple (Meijer)	100
	Generic Cranberry (Meijer)	140
	Generic Orange Juice (Meijer)	110
	Generic Cran-Grape (Meijer)	150
	Motts Apple Juice	120
	Ocean Spray Cran-Grape	130
	Ocean Spray Cran-Mango	120
	Ocean Spray Cran-Cherry	130
	Florida Orange Juice	110
	R.W. Knudsen Blueberry	100
	R.W. Knudsen Cranberry	70
	Juicy Juice Orange Tangerine	130
	Juicy Juice Apple	110
	Tropicana Orange Juice	110
	Minute Maid Orange Juice	110
	Indian Summer Apple Juice	120
	Old Orchard Apple Juice	120
	V8 Splash Tropical Orange	100
	V8 Concord Grape/Raspb	120
100% Juice Average Energy: 113 kcals/8oz		
Fruit Drink (Non-100% Juice	Tang	90
	Orange Kool-aid Jammer	70
	Grape Kool-aid Jammer	30

Energy Consumption Estimation		
Fruit Drink (Non-100% Juice)	Peach Mango Kool-aid Jammer	70
	Sunny-D	50
	Hawaiian Punch Polar Blast	60
	Hawaiian Punch Fruit Juicy Red	60
	Hawaiian Punch Berry Bonkers	60
	Capri-Sun Orange	67
	Capri-Sun Fruit Punch	67
	Capri-Sun Wild Cherry	67
	Orange Kool-aid	60
	Grape Kool-aid	60
	Cherry Kool-aid	60
Fruit Drink Average Energy: 62 kcals/8oz		
Soft Drinks (Soda Pop)	Barq's Root Beer	107
	Pepsi	100
	Mountain Dew	113
	Royal Crown Cola	107
	Vanilla Coca-Cola	100
	Coca-Cola	93
	Sierra Mist	80
	Sprite	93
	Dr. Pepper	100
Soft Drink Average Energy: 99 kcals/8oz		
Nutritional Supplement	Strawberry Pediasure	240
	Chocolate Pediasure	240
	Vanilla Pediasure	240
	Banana Pediasure	240
	Chocolate Kids Boost Essentials	233
	Vanilla Kids Boost Essential	233
Nutritional Supplement Average Energy: 238 kcals/8oz		
Tea	Arizona Southern Style Sweet Tea	90
	Lipton Pure Leaf Lemon	67
	Lipton Pure Leaf Peach	67
	Snapple Raspberry	73
	Gold Peak Sweet Tea	80
	Tradewinds Extra Sweet Tea	113
	Sweet Pure Leaf	69

Energy Consumption Estimation		
Tea Average Energy: 82 kcals/8oz		
Sports Drinks	Orange Powerade	53
	Grape Powerade	53
	Orange Gatorade	53
	Fruit Punch Gatorade	53
Sport Drink Average Energy: 53 kcals/8oz		

Anthropometric Assessment

Height and weight was measured at the time of the child's usual WIC appointment. Height and weight measurements were performed by WIC dietitians trained in the proper procedures and protocols for measuring and recording results in accordance with Marion County Health Department standards. WIC dietitians receive annual training for HIPPA.

Height

Height was measured using a standometer with shoes off, feet flat on the ground, and heels against the standometer. Standometers used were the Easy-Glide Bearing Stadiometer (Perspective Enterprise, wall-mounted model PE-WM-60-76-BRG2) and Seca 213 Portable Free-Standing Stadiometer (Seca, model 213).

Weight

Weight was measured with children in light clothing and no shoes. Scales used at the two WIC clinics were: BWB-800S Doctor Scale (Tanita Corp: 440-lb capacity, 0.2-lb resolution), Doran DS6100 (BMI function, 500-lb capacity, 0.2-lb resolution, and Healthometer 752KL (BMI function, 600-lb capacity, 0.2-lb resolution). All scales are calibrated yearly by the Indianapolis Department of Code Enforcement (weights and measures inspection) to ensure accuracy.

Risk of overweight or obesity in childhood was determined by plotting height and weight on 2000 CDC growth charts. Any BMI percentile $\geq 85^{th} < 95^{th}$ was defined as overweight and $\geq 95^{th}$ was defined as obese.

Statistical Methods

The associations of beverage intake (amounts and energy intake estimates) with weight percentile and BMI percentile was evaluated using plots and correlation coefficients. The associations of beverage intake with overweight or obese classification was tested using logistic regression. Statistical Analysis System (SAS) 9.4 was used for all statistical measures tested.

The final kilocalories column from drinks were used. Since most of the kilo-calories are set up as ranges, the midpoints from each range were used. Each beverage was separately looked at and then all beverage categories as a total (Variable "Calories all"). BMI percentiles were used as a continuous variable, BMI% $\geq$ 95 is obese and 85 $\geq$ BMI% < 95 is overweight. Overweight/obese were combined then a two group comparison (overweight/obese vs normal) for each of the outcomes was performed. Two-sample t-test was used for continuous outcome, and exact chi-square test was used for categorical outcomes. In addition, the summary stats for BMI%, BMI% categories, overall kilocalories and kilocalories by beverage, and the sociodemographics are shown in tables five and six.

Subjects

As shown in Table A-5 a total of 30 child parent pairs participated in the study. The children had a mean age of 2.9± 0.5 years. The sample of children was 80% African American/Black, 6.7% Caucasian/White, and 13.3% Hispanic/Latino. The mean BMI percentile of the study population was 62.7%± 31.8, indicating that the sample as a whole was normal weight. Within the study population, eight out of the thirty children (27%) were overweight/obese with a mean BMI percentile of 97.4%±1.98 (See Table A-7). Ten of the mothers had either a two-year or four-year college degree and twelve mothers had some high school. Out of the eight children who were overweight/obese, three of the mothers a college level education; the other five mothers had high school level or below education. Although the difference in household size was not significant, the mean household size for overweight/obese children (4.3±0.85) was slightly larger than household size for of normal weight children (3.4±1.41). A majority of households (90%) in the study reported incomes of making $30,000 or less. Seven of the eight overweight/obese children belong to households with incomes of $30,000 or less.

Results

There were twenty-two children in the study of normal weight (N = 22) and eight children who were overweight/obese (N = 8). BMI percentiles (refer to Tables A-5, A-7) were found to be significant ($P < 0.001$) between normal weight children (mean BMI percentile of 50 + 27.7) and overweight/obese children (97.4 + 1.98).

As shown in A-6, total energy consumption from beverages was not significantly different between normal weight children (mean of 803.1 $\pm$ 305.3 kilocalories) and overweight/obese children (mean of 779.5 $\pm$ 125.6 kilocalories). Although none of the differences approached significance, there were differences in reported intake for beverage categories. In this study overweight/obese children consumed more energy from soda (101 $\pm$ 192.9 kilocalories) than normal weight children (78 $\pm$ 84.9 kcal) and more non-100% juice (142 $\pm$ 86.8 kilocalories) than normal weight children (129.1 $\pm$ 105.5 kcal) (refer to Table A-6). Overweight obese children consumed more energy from sports drinks (66.3 $\pm$ 94 kilocalories) than normal weight children (26.5 $\pm$ 47kcal) and less energy from milk (268.8 $\pm$ 156.4 kilocalories) than normal weight children (373.6 $\pm$ 249.5 kilocalories). Normal weight children consumed more nutritional supplements (92.0 $\pm$ 168 kilocalories) versus none for overweight/obese children. In this study, consumption of energy containing beverages did not explain the differences in BMI percentiles between the children.

Discussion

Although none of the differences approached significance, there were differences in reported intake for beverage categories between the two groups of children. In this study (Table A-6) overweight/obese children consumed more energy from soda (101 ± 192.9 kilocalories) than normal weight children (78 ± 84.9 kcal) and more non-100% juice (142 ± 86.8 kilocalories) than normal weight children (129.1 ± 105.5 kcal). Overweight obese children consumed more energy from sports drinks (66.3 ± 94 kilocalories) than normal weight children (26.5 ± 47kcal) and less energy from milk (268.8 ± 156.4 kilocalories) than normal weight children (373.6 ± 249.5 kilocalories). These findings were similar to what McElligot et al. (2012) found in a South Carolina WIC population where children who consumed more fruit juice consumed less milk. Marshall et al (2005) also reported an inverse relationship between milk intake and juice drinks, sodas, and other SSBs in the population that Marshall studied.

Unlike Torre et al. who found a positive association between sugar-sweetened beverage consumption and risk of obesity, no such association was determined in this study. The present study is in agreement with the findings of Newby et al. who determined in a prospective examination of 1,345 children enrolled in North Dakota WIC program that there was no significant association between weight change and beverage intake. Similar findings were reported by Skinner and Carruth using a longitudinal survey of 72 children. Sinner and Carruth, found no statistical significance in association between juice consumption and children's height, weight, or BMI as tested by linear models.

The finding from Newby et al. and Skinner and Carruth may be similar to what the present study found; however the sample size (N = 30; Newby N = 1,345; Skinner and Carruth N = 72) and race/ethnicity differed significantly from both studies. The majority of Newby's study sample was composed of Caucasian and Native American children (95%) and Skinner and Carruth's sample were all white children; whereas the majority of our sample was African American (80%). It is possible that ethnicity may not be a significant factor. The small sample of the present study, could explain why no significant relationship between energy consumed from beverages and the risk of overweight/obesity in children found. In the future to increase sample size gift cards as incentives and the use of more WIC clinics would be utilized.

One unexpected finding was the level of consumption of nutritional supplements (Pediasure, Kids Boost). The mean energy consumed from nutritional supplements by children in the normal weight group was 92 $\pm$ 168 kilocalories. There was no consumption of nutritional supplements in the overweight/obese group. Out of all the beverage categories, nutritional supplements appear to be used in ways never intended.

In the author's experience, mothers on the Indiana WIC program may state that their child (or children) "will not eat" or "has no appetite" and ask for, or sometimes request, Pediasure as an appetite enhancer. Many parents fail to realize that Pediasure will not increase their child's appetite or make them want to eat. Introducing Pediasure could result in maladaptive eating patterns. Parents sometimes use Pediasure as a meal replacement when their child does not eat or does not eat well enough. When kids are consuming more calories from Pediasure than from actual food they miss out on a variety of textures and flavors. Parents seem unaware that their child's appetite is tied to their particular growth rate, meaning appetite will increase and decrease over the course of their child development. When their child “will not eat” parents will rely on Pediasure as a meal replacement. It is not uncommon for parents to tell the dietitian that their child drinks three cups of whole milk (160 kilocalories/8oz) and two or three Pediasures (260 kilocalories/8oz bottle). Three cups of whole milk is 480 kilocalories and three Pediasures is 780 kilocalories equaling 1,260 kilocalories intake. That 1,260 kilocalories is just coming from milk and Pediasure which will definitely have an impact on any child’s appetite and overall variety in their diet.

The misuse of nutritional supplements such as Pediasure is complicated by the role played by physicians. When approached by a parent with concerns about child appetite or unwillingness to eat, physicians will write prescriptions for Pediasure. In the author’s experience it is common to find overweight and obese children seen at WIC clinics with prescriptions for Pediasure from their doctors.

There is also some indication that children may be prescribed Pediasure as therapy for “failure to thrive” because of a failure to correctly interpret pediatric growth charts. The child’s length-for-age is low (child is short), their weight-for-age is low, but their weight-for-length is around the 50^{th} percentile. In the author’s experience a physician may see a weight-for-age below the 10^{th} percentile and tell the parent to give two Pediasures a day and state their reasoning as “failure to thrive” without reference to child’s length or family height history. It would appear that the prescribing of Pediasure is viewed as relatively free of side effects by physicians and a way to deal with parental anxiety over change in child growth rate and appetite. Use of nutritional supplements in the WIC population should be addressed in future studies.

A second unexpected finding was the high degree of variability in milk consumption. Daily consumption of milk varied from roughly half-cup to seven cups per day. Milk is an important source of nutrients for children particularly protein, calcium, magnesium, riboflavin, thiamin and Vitamins A&D. Future research should consider determining the actual level of milk consumption in children on the WIC program. Parents of children on WIC in Marion County are educated that the recommended serving amount for dairy is two cups per day (see Figure A-1) since excessive milk consumption, which there is no clear definition on what excessive is, can inhibit iron absorption, but also can affect appetite depending on the quantity consumed.

Other factors, such as household income, parental education and household size, may also play a role in child rearing practices and should be investigated further. Thirty-two percent (n=7) of the normal weight children lived in household with incomes of $20,000 or less while 63% (n=6) of the overweight/obese children came from households with incomes $20,000 or below. In this study, the majority of overweight/obese children (n=5, 63.5%) had mothers still in high school or who earned a GED. The mean household size was slightly larger for the overweight/obese group (4.3 $\pm$ 0.85) than for the normal weight group (3.4 $\pm$ 1.41). If the sample size was larger, the effect of household size might be elucidated. This study did not ask marital status, but for future endeavors, this question will be posed. In a single parent household, especially if the parent is working, time can be in short supply resulting in more quick service meals. A stressed single parent may deal somewhat differently with a fussy child versus a two-parent household. A single parent may placate or soothe a fussy child with food whereas a two-parent household may engage the child in an activity. For a single parent household it may be easier to provide what the child is willing to consume irrespective of nutritional quality, and in many instances Pediasure is used.

This study developed a simple food frequency questionnaire suitable for tracking consumption of energy containing beverages in future work. An additional strength of the study was that all questionnaire responses were confirmed by interview with the investigator. The present study limits include the small sample size and the potential for under- and over-reporting beverage intake. Future work should consider providing a gift card or incentive to thank parents for participating in the survey. Additional studies should consider investigating the role of house hold size, the use of nutritional supplements, and determining the level and kind of milk intake in this population.

Appendix

Table A-1: Obesity Prevalence

Author(s)	Age Group (years)	Percent Obese	Surveillance System Utilized
Dalenius 2012	2-4	14.4	PedNSS 2010
Ogden, CL, 2010	2-5	10.4	NHANES 2007-2008
Ogden, Carroll, Kit, & Flegal, 2012	2-5	12.1	NHANES 2009-2010

Table A-2: Consumption of Sweet Drinks (Juice and SSBs) and Weight Status

AOR at Follow-up of 3-4 year olds by Consumption of Sweet Drinks (Juice and SSBs) and Weight Status Compared to Referent Drink (< 1 drink/day)		
Sweet Drinks Per Day	At Risk for Being Overweight at Baseline	Overweight at Baseline
1 - < 2	2.0 (1.3-3.2)	2.1 (1.3-3.4)
2 - < 3	2.0 (1.2-3.2)	2.2 (1.4-3.7)
≥ 3	1.8 (1.1-2.8)	1.8 (1.1-2.9)
AOR (Adjusted Odds Ratio); 95% CI		

*Welsh et al. 2005

Table A-5: Sociodemographics

Variables	Total Population N = 30 Children (%)	Normal Weight N = 22 (%)	Overweight/Obese N = 8 (%)	P Value
Age of Child				0.105^{T}
Mean $\pm$ SD	2.9 $\pm$ 0.5	2.8 $\pm$ 0.5	3.3 $\pm$ 0.8	
Median (min – max)	3.0 (2.0 – 4.0)	3.0 (2.0 – 4.0)	3.0 (2.0 – 4.0)	
Race of Child				0.303^{C+}
African American/Black	24 (80)	19 (86.3)	5 (63)	
Caucasian/White	2 (6.7)	1 (4.5)	1 (12)	
Hispanic/Latino	4 (13.3)	2 (9.1)	2 (25)	
Child BMI Percentile				$< .001^{T}$
Mean $\pm$ SD	62.7 $\pm$ 31.8	50.0 $\pm$ 27.7	97.4 $\pm$ 1.98	
Median (min – max)	67.3 (14.6 – 100.0)	53.3 (14.6 – 89.7)	97.2 (94.3 – 100.0)	
BMI Categories				$< .001^{C+}$
Normal	22 (73)	22 (100)	0 (0.0)	
Overweight	1 (3.3)	0 (0.0)	1 (13)	
Obese	7 (23)	0 (0.0)	7 (88)	
Highest Level of Education (Parents)				0.972^{C+}
4 Year College Degree	5 (17)	4 (18)	1 (13)	
2 Year College Degree	5 (17)	3 (14)	2 (25)	
Vocational School	2 (6.7)	2 (9.1)	0 (0.0)	
GED	6 (20)	5 (23)	1 (13)	
Senior in Highschool	9 (30)	6 (27)	3 (37.5)	
Junior in Highschool	3 (10)	2 (9.1)	1 (13)	
Household Size				0.114^{T}
Mean $\pm$ SD	3.6 $\pm$ 1.1	3.4 $\pm$ 1.41	4.3 $\pm$ 0.85	
Median (min – max)	3.5 (2.0 – 7.0)	3.0 (2.0 – 7.0)	4.5 (3.0 – 5.0)	
Household Income				0.266^{C+}
$20,000 or below	12 (40)	7 (32)	5 (63)	
$20,000-$30,000	15 (50)	13 (59)	2 (25)	
$30,000-$40,000	1 (3.3)	1 (4.5)	0 (0.0)	
$40,000-$50,000	1 (3.3)	1 (4.5)	0 (0.0)	
$50,000 or above	1 (3.3)	0 (0.0)	1 (13)	

$^{+}$: exact test

^{T} : t-test

^{C} : Chi-square test

Table A-6: Average Energy Consumed by Children in Each Beverage Category

Beverage Category	Total Population kilocalories (kcals) (N = 30)	Normal Weight kcals (N = 22)	Overweight/Obese Weight kcals (N=8)	P Value
Mid 100% Juice				0.335^{T}
Mean ± SD	318.6 ± 168.7	300.4 ± 169.8	368.8 ± 166.0	
Median (min – max)	295.0 (118.0 – 649.0)	295.0 (118.0 – 649.0)	354.0 (177.0 – 649.0)	
Mid non-100% Juice				0.759^{T}
Mean ± SD	132.5 ± 99.7	129.1 ± 105.5	142.0 ± 86.8	
Median (min – max)	106.5 (0.0 – 390.5)	106.5 (0.0 – 390.5)	142.0 (0.0 – 248.5)	
Mid Milk				0.278^{T}
Mean ± SD	345.7 ± 230.6	373.6 ± 249.5	268.8 ± 156.4	
Median (min – max)	275.0 (100.0 – 880.0)	300.0 (100.0 – 880.0)	250 (100.0 – 550.0)	
Mid Nutritional Supplement				0.137^{T}
Mean ± SD	67.4 ± 149.0	92.0 ± 168.0	0.0 ± 0.0	
Median (min – max)	0.0 (0.0 – 595.0)	0.0 (0.0 – 595.0)	0.0 (0.0 – 0.0)	
Mid Soda				0.650^{T}
Mean ± SD	84.2 ± 119.4	78.0 ± 84.9	101.0 ± 192.9	
Median (min – max)	101.0 (0.0 – 555.5)	101.0 (0.0 – 353.5)	0.0 (0.0 – 555.5)	
Mid Sport Drink				0.133^{T}
Mean ± SD	37.1 ± 63.5	26.5 ± 47.0	66.3 ± 94.0	
Median (min – max)	0.0 (0.0 – 238.5)	0.0 (0.0 – 185.5)	26.5 (0.0 – 238.5)	
Mid Sweet Tea				0.986^{T}
Mean ± SD	27.6 ± 66.3	27.7 ± 71.8	27.2 ± 51.8	
Median (min – max)	0.0 (0.0 – 304.5)	0.0 (0.0 – 304.5)	0.0 (0.0 – 130.5)	
Total Energy (kcals)				0.835^{T}
Mean ± SD	796.8 ± 267.3	803.1 ± 305.3	779.5 ± 125.6	
Median (min – max)	775.5 (297.0 – 1659.5)	781.5 (297.0 – 1659.5)	748.3 (643.5 – 958.5)	

$^{+}$: exact test
^{T} : t-test
^{C} : Chi-square test

Table A-7: BMI Percentiles Across Categories

Variables	Total Population N = 30 Children (%)	Normal Weight N = 22 (%)	Overweight/ Obese N = 8 (%)	P Value
Child BMI Percentile				< .001^{T}
Mean $\pm$ SD	62.7 $\pm$ 31.8	50.0 $\pm$ 27.7	97.4 $\pm$ 1.98	
Median (min – max)	67.3 (14.6 – 100.0)	53.3 (14.6 – 89.7)	97.2 (94.3 – 100.0)	
BMI Categories				< .001^{C+}
Normal	22 (73)	22 (100)	0 (0.0)	
Overweight	1 (3.3)	0 (0.0)	1 (13)	
Obese	7 (23)	0 (0.0)	7 (88)	

$^{+}$: exact test
^{T} : t-test
^{C} : Chi-square test

Figure A-1: Food Group Servings Recommendation for Children

"Why does it matter what I do?"

- **They learn by watching you.** Kids get curious when they see you eating fruits or vegetables. Before you know it, they'll want to taste what you are having.
- **You teach them lessons they'll use for life.** It's normal for 2- to 5-year-olds to be "picky" eaters. Help them increase the types of fruits and vegetables they like by setting a good example.

What about fats and sweets?

I need some fat. You can put butter, margarine, or salad dressing on my foods. A little sugar is okay, too.

TIP: Make half of my grains whole. Choose grains like wheat, oats, rye or barley.

FOOD GROUP	WHAT COUNTS AS ...	TIPS
GRAINS 3 Ounces	**1 OUNCE OF GRAINS?** • 1 slice bread • 1-cup ready-to-eat cereal flakes • ½ cup cooked rice or pasta • 1 tortilla (6" across)	Try a new WIC cereal
VEGETABLES 1 Cup	**½ CUP OF VEGGIES?** • ½ mashed, sliced, or chopped vegetables • 1-cup raw leafy greens • ½ cup vegetable juice • 1 small ear of corn	• Offer many kinds and colors: dark green, orange, red, yellow, and purple. • Try raw spinach or lettuce. I can dip pieces in salad dressing.
FRUITS 1 Cup	**½ CUP OF FRUIT?** • ½ cup mashed, sliced or chopped fruit • ½ cup 100% fruit juice • ½ medium banana • 4-5 large strawberries	• Many kinds and colors: red, yellow, orange, blue, and green. • 4 ounces of juice a day is plenty.
MILK & MILK PRODUCTS 2 Cups	**½ CUP OF DAIRY?** • ½ cup milk • 4 ounces yogurt • ¾ ounce cheese • 1 string cheese	• 16 ounces of milk a day is plenty.
MEAT & BEANS 2 Ounces	**1 OUNCE OF PROTEIN FOODS?** • 1 ounce cooked meat, poultry, or seafood • 1 egg • 1 Tablespoon peanut butter • ¼ cup cooked beans or peas (kidney, pinto, lentils)	• Try well-done, moist, chopped meats and cooked WIC beans. • I get peanut butter from WIC. Teach me to eat it. Spread it thin and make it moist with some applesauce or jelly.

References

Dalenius K, Borland E, Smith B, Polhamus B, Grummer-Strawn L. (2012). Pediatric NutritionSurveillance

2010 Report. Atlanta: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention.

DeBoer, M.D., Scharf, R.J., and Demmer, R.T. (2013). Sugar-Sweetened Beverages and Weight Gain in 2- to 5-Year Old Children. *Pediatrics*. 132, 413-420. doi:10.1542/peds.20130570.

Dubois, L., Farmer, A., Girard, M., & Peterson, K. (2007). Regular sugar-sweetened beverage consumption between meals increases risk of overweight among preschool-aged children. *J Am Diet Assoc, 107*(6), 924-934; discussion 934-925. doi: 10.1016/j.jada.2007.03.004

Faith, M. S., Dennison, B. A., Edmunds, L. S., & Stratton, H. H. (2006). Fruit Juice Intake Predicts Increased Adiposity Gain in Children From Low-Income Families: Weight Status-by-Environment Interaction. *Pediatrics, 118*(5), 2066-2075. doi: 10.1542/peds.2006-1117

Fulgoni, V. L., 3rd, & Quann, E. E. (2012). National trends in beverage consumption in children from birth to 5 years: analysis of NHANES across three decades. *Nutr J, 11*, 92. doi: 10.1186/1475-2891-11-92

Han, E., & Powell, L. M. (2013). Consumption patterns of sugar-sweetened beverages in the United States. *J Acad Nutr Diet, 113*(1), 43-53. doi: 10.1016/j.jand.2012.09.016.

Indiana State Department of Health (2014). Indiana WIC Annual Report 2014. Accessed 26 March 2016. www.in.gov/isdh/files/14_WIC_Annual_Report_Final.pdf

Kant, A. K., & Graubard, B. I. (2010). Contributors of water intake in US children and adolescents: associations with dietary and meal characteristics—National Health and Nutrition Examination Survey 2005–2006. *The American Journal of Clinical Nutrition, 92*(4), 887-896. doi: 10.3945/ajcn.2010.29708.

Keller, K. L., Kirzner, J., Pietrobelli, A., St-Onge, M. P., & Faith, M. S. (2009). Increased sweetened beverage intake is associated with reduced milk and calcium intake in 3- to 7-year-old children at multi-item laboratory lunches. *J Am Diet Assoc, 109*(3), 497-501. doi: 10.1016/j.jada.2008.11.030.

Kral, T. V., Stunkard, A. J., Berkowitz, R. I., Stallings, V. A., Moore, R. H., & Faith, M. S. (2008). Beverage Consumption Patterns of Children Born at Different Risk of Obesity. *Obesity, 16*(8), 1802-1808.

Levine, D.M., Stephan, D.F., and Szabat, K.A. (2013). Statistics for Managers Using Microsoft Excel. *Pearson*, 7th edition. ISBN-10: 0133061817.

Lim, S., Zoellner, J. M., Lee, J. M., Burt, B. A., Sandretto, A. M., Sohn, W., . . . Lepkowski, J. M. (2009). Obesity and Sugar-sweetened Beverages in African-American Preschool Children: A Longitudinal Study. *Obesity, 17*(6), 1262-1268.

Lu, L., Xun, P., Wan, Y., He, K., and Cai, W. (2016) Long-term Association between Dairy Consumption
and Risk of Childhood Obesity: A Systemic Review and Meta-Analysis of Prospective Cohort Studies. *European Journal of Clinical Nutrition*. (70) 414-423. doi: 10.1038/ejcn.2015.226.

Maalouf-Manasseh, Z., Metallinos-Katsaras, E., & Dewey, K. G. (2011). Obesity in preschool children is more prevalent and identified at a younger age when WHO growth charts are used compared with CDC charts. *J Nutr, 141*(6), 1154-1158. doi: 10.3945/jn.111.138701

Marshall, T. A., Eichenberger Gilmore, J. M., Broffitt, B., Stumbo, P. J., & Levy, S. M. (2005). Diet quality in young children is influenced by beverage consumption. *J Am Coll Nutr*, *24*(1), 65-75.

McElligott, J. T., Roberts, J. R., Varadi, E. A., O'Brien, E. S., Freeland, K. D., & Basco, W. T., Jr. (2012). Variation in fruit juice consumption among infants and toddlers: associations with WIC participation. *South Med J, 105*(7), 364-369. doi: 10.1097/SMJ.0b013e31825c0252

Nelson, J. A., Carpenter, K., & Chiasson, M. A. (2006). Diet, activity, and overweight among preschool-age children enrolled in the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC). *Prev Chronic Dis, 3*(2), A49.

Newby, P. K., Peterson, K. E., Berkey, C. S., Leppert, J., Willett, W. C., & Colditz, G. A. (2004). Beverage consumption is not associated with changes in weight and body mass index among low-income preschool children in North Dakota. *Journal of the American Dietetic Association, 104*(7), 1086-1094. doi: http://dx.doi.org/10.1016/j.jada.2004.04.020

Nickelson, J., Lawerence, J.C., Parton, J.M., Knowlden, A.P., and McDermott, R.J. (2014). What Proportion of Preschool-Aged Children Consume Sweetened Beverages? *Journal School of Health*. 84(3), 185-194. doi: 10.1111/josh.12136.

Nicklas Ta, O. N. C. E. K. R. (2008). ASsociation between 100% juice consumption and nutrient intake and weight of children aged 2 to 11 years. *Archives of Pediatrics & Adolescent Medicine, 162*(6), 557-565. doi: 10.1001/archpedi.162.6.557

O'Connor, T. M., Yang, S.-J., & Nicklas, T. A. (2006). Beverage Intake Among Preschool Children and Its Effect on Weight Status. *Pediatrics, 118*(4), e1010-e1018. doi: 10.1542/peds.2005-2348

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), 483-490. doi: 10.1001/jama.2012.40

Ogden Cl, C. M. D. C. L. R. L. M. M. F. K. M. (2010). PRevalence of high body mass index in us children and adolescents, 2007-2008. *JAMA, 303*(3), 242-249. doi: 10.1001/jama.2009.2012

Savage, J. S., Fisher, J. O., & Birch, L. L. (2007). Parental influence on eating behavior: conception to adolescence. *J Law Med Ethics, 35*(1), 22-34. doi: 10.1111/j.1748-720X.2007.00111.x

Scharf, R.J., Demmer, R.T., and DeBoer, M.D. (2013). Longitudinal Evaluation of Milk Type Consumed and Weight Status in Preschoolers. *Arch Dis Child*. 98: 335-340. doi: 10.1136/archdischild-2012-302941.

Sekhobo, J. P., Edmunds, L. S., Reynolds, D. K., Dalenius, K., & Sharma, A. (2010). Trends in prevalence of obesity and overweight among children enrolled in the New York State WIC program, 2002-2007. *Public Health Rep, 125*(2), 218-224.

Siega-Riz, A. M., Kranz, S., Blanchette, D., Haines, P. S., Guilkey, D. K., & Popkin, B. M. (2004). The effect of participation in the WIC program on preschoolers' diets. *J Pediatr*, *144*(2), 229-234. doi: 10.1016/j.jpeds.2003.10.052

Skinner, J. D., & Carruth, B. R. (2001). A Longitudinal Study of Children's Juice Intake and Growth: The Juice Controversy Revisited. *Journal of the American Dietetic Association, 101*(4), 432-437. doi: http://dx.doi.org/10.1016/S0002-8223(01)00111-0

Slinging, M.M., Mathias, K.C., and Popkin, B.M. (2013). Trends in Food and Beverage Sources among US Children and Adolescents: 1989-2010. *Journal of the Academy of Nutrition and Dietetics*. 113: 1683-1694. doi: 10.1016/j.jand.2013.06.001.

Snedecor, G.W., and Cochran, W.G. (1989). Statistical Methods. *Iowa State University Press*, 8th edition. ISBN-10: 0813815614.

Spence, L. A., Cifelli, C. J., & Miller, G. D. (2011). The Role of Dairy Products in Healthy Weight and Body Composition in Children and Adolescents. *Curr Nutr Food Sci, 7*(1), 40-49. doi: 10.2174/157340111794941111

Torre, S.B.D., Keller, A., Depeyre, J.L., and Kruse, M. (2016). Sugar-Sweetened Beverages and Obesity Risk in Children and Adolescents: A Systematic Analysis on How Methodological Quality May Influence Conclusions. *Journal of the Academy of Nutrition and Dietetics*. 116: 638-659. http://dx.doi.org/10.1016/j.jand.2015.05.020.

USDA. (2012a). Retrieved June 05, 2013, from http://www.fns.usda.gov/wic/aboutwic/mission.htm

USDA. (2012b). Nutrition Program Facts: WIC- The Special Supplemental Nutrition Program for Women, Infants, and Children. Retrieved June 05, 2013, from http://www.fns.usda.gov/wic/WIC-Fact-Sheet.pdf

Wang Y, L. D. S. S. K. G. S. L. (2009). IMpact of change in sweetened caloric beverage consumption on energy intake among children and adolescents. *Archives of Pediatrics & Adolescent Medicine, 163*(4), 336-343. doi: 10.1001/archpediatrics.2009.23

Wang, Y. C., Bleich, S. N., & Gortmaker, S. L. (2008). Increasing caloric contribution from sugar-sweetened beverages and 100% fruit juices among US children and adolescents, 1988-2004. *Pediatrics, 121*(6), e1604-1614. doi: 10.1542/peds.2007-2834

Welsh, J. A., Cogswell, M. E., Rogers, S., Rockett, H., Mei, Z., & Grummer-Strawn, L. M. (2005). Overweight among low-income preschool children associated with the consumption of sweet drinks: Missouri, 1999-2002. *Pediatrics, 115*(2), e223-229. doi: 10.1542/peds.2004-1148

Curriculum Vitae

Joshua J. Foster

Education
Masters of Science in Adult Nutrition

Professional Experience
Dietitian for the Marion County Public Health Department WIC Program