THE IMPACT OF BEVERAGE TYPE INTAKE ON ENERGY INTAKE AND WEIGHT IN 12-MONTH-OLD LOW-INCOME HISPANIC INFANTS

By

CAROLINA ESPINOSA

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ABSTRACT OF THE THESIS

The impact of beverage type intake on energy intake and weight

in 12-month-old low-income Hispanic infants

By Carolina Espinosa

Thesis Director:

John Worobey, Ph.D.

According to the 2008 Pediatric Nutrition Surveillance Survey, low-income Hispanic children aged 2-4 years have the highest prevalence for overweight at 18.4 % compared to non-Hispanic Whites at 12.6 % and non-Hispanic Blacks at 11.8 %. Current research has found that sugar-sweetened beverage (SSB) intake may be a major factor contributing to the over consumption of calories among children. Food preferences can also develop as early as the first of year of life. Therefore, if SSBs become part of a regular diet as early as the first year of life it has the potential to reinforce the preference for sweet tasting foods for which infants are biologically predisposed.

The objective of this was to look at how sweetened-beverage intake impacted overall energy intake and weight status among 12-month-old infants from low-income Hispanic households. Participants were divided into non-SSB consumers and SSB consumers. It was found that non-SSB consumers ingested significantly more fluid ounces of plain milk, consumed significantly less carbohydrate (grams/day), had a significantly higher percentage of calories come from fat, and ingested significantly less vitamin C than the SSB consumers. For participants above the 85th percentile for weight

for length, the non-SSB consumers ingested significantly more calories from plain milk/formula Consumption of high-energy dense foods, such as sugar-sweetened beverages, is still an important aspect of the diet to target among Hispanics who are high risk for becoming overweight or obese.

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I. Introduction

Obesity in the United States has become a top public health concern. According to the National Health and Nutrition Examination Survey (NHANES) 2003-2006, the prevalence for overweight and obese adult Americans is currently 65 percent (Ogden, Carroll, McDowell & Flegal, 2007). For adults, overweight status is defined as having a body mass index (BMI) between 25 and 29.9 and obese status is defined as having a BMI greater than or equal to 30 (BMI, a ratio of weight in kilograms over height in meters squared). According to the Behavioral Risk Factor Surveillance System (BRFSS) survey 2006-2008, non-Hispanic Blacks have the highest prevalence of obesity at 35.7 percent, Hispanics have an obesity prevalence of 28.7 percent, and non-Hispanic Whites have an obesity prevalence of 23.7 percent (Pan et al., 2009; Centers for Disease Control and Prevention, BRFSS, 2006-2008).

According to the Centers for Disease Control and Prevention (CDC), children younger than 2-years of age can be defined as overweight if their weight-for-length percentile is at or above the 95^{th}. According to a National Health Statistics Report, children ages 2 and older are defined as overweight ($\geq 85^{th}$ BMI-for-age percentile) or obese ($\geq 95^{th}$ BMI-for-age percentile) based on their gender specific BMI-for-age percentile growth charts (Ogden, & Flegal, 2010). Overweight among children was formerly termed at risk for overweight and obese was termed overweight. The 2008 Pediatric Nutrition Surveillance System (PedNSS) survey shows that Hispanic children from the ages of 2 to 4 have the highest prevalence of obesity (18.5 %) compared to non-Hispanic Blacks (11.8 %) or non-Hispanic Whites (12.6 %) (Sharma et al., 2010). The literature also supports the statement that the prevalence of obesity is exacerbated by a low socioeconomic background (Metallinos-Katsaras, Sherry, & Kallio, 2009; Moore & Diez Roux, 2006). The PedNSS survey further shows that pre-school age Hispanic children who come from low-income families that participate in federally funded assistance programs have the highest prevalence of obesity out of all low-income minority pre-school aged children (Sharma et al., 2010). This makes Hispanic children an important target group in the field of community nutrition and health.

It is clear that there are differences in the prevalence of obesity between different racial groups. This raises the importance of being aware of how genes are a major factor influencing the risk for obesity. However, it is not clear how susceptible to obesity each race is on a genetic level given a similar living environment. What is known is that genes and the environment both play a major role in the etiology of obesity. Studies using twins that have been raised in separate environments have shown that their weight status is largely determined by the BMI of the biological parents, particularly the mothers but is also partly influenced by their exposure to the environment (Wardle, Carnell, Haworth, & Plomin, 2008). Genes and the environment were once in balance helping humans survive during periods of food shortage, but this has been disturbed by the fast pace of industrialization (Bouchard, 2007; Bendich & Deckelbaum, 2001). Historically, it is shown that before a group of people experienced industrialization, poverty, malnutrition, and communicable diseases were the major problems (Caballero, 2007). In the early part of the 20th Century, sugar and fat were added to commonly consumed foods in order to decrease malnutrition by increasing the energy density of foods. This would then help increase body size, which could spill over to improving “industrial productivity” (Caballero, 2007, p. 1; Boyd-Orr, 1937). The human genotype has developed over hundreds of years in the face of gradual environmental changes. However, with increased development and technology, the human genotype has not been able to keep pace with how fast the environment is changing, making increased energy intake a major health concern (Bendich & Deckelbaum, 2001).

It is important to note that the interaction between genes and the environment and its association with obesity is not completely unalterable. Unlike the genetic make-up of a person, the environmental factors can be altered in order to help prevent weight issues throughout life and help prevent the influence of genetics on the susceptibility to obesity due to a high parental BMI status. The challenge herein is how that can be done? Right now, the highest risk groups among adults are low-income minority groups and specifically among low-income Hispanic children. Research has shown that the mere fact of living in a low-income community increases the risk of becoming obese due to the many barriers to physical activity and inaccessibility to quality healthy foods (Moore & Diez Rouz, 2006; Baker, Schootman, Barnidge & Kelly, 2006).

Affordable quality produce is often difficult to come by in communities mostly comprised of low-income households. The local food environment also plays a major role in determining the overall diet of residents in that neighborhood (Horowitz, Colson, Hebert, & Lancaster, 2004; Morland, Wing, & Diez Roux, 2002). The foods that tend to be inexpensive and provide the most energy per given unit tend to have a high fat, high salt, or high sugar content. In a study by Drewnowski and Specter (2004), it was shown that as the cost of food decreases the energy density of the food increases, along with more palatability. They concluded that the low cost of energy dense food along with its high palatability promotes the overconsumption of calories. In particular, sugar sweetened beverages have become a major concern in terms of its impact on daily calorie consumption and added sugar intake (Ludwig, Peterson, & Gortmaker, 2001; O'Connor, Yang, & Nicklas, 2006; LaRowe, Moeller, & Adams, 2007). It has also been found in a study by Horowitz et al. (2004), conducted in New York City, that healthy food options in stores located in low-income mostly minority neighborhoods are more expensive than the same healthy food options offered in stores located in more affluent communities. Another study found that because chain grocery stores are not readily found, if at all, in low-income disadvantaged neighborhoods, residents often have to pay a premium price for products that would otherwise be cheaper at a chain grocery store (Chung & Myers Jr., 1999).

It is important to understand the environmental dietary factors contributing to the onset of overweight and obesity, especially during early development when infants are introduced to their first foods and have a biological predisposition and therefore preference for sweet tastes. Food preferences that develop in children are largely influenced by what is available in their surroundings—the home and neighborhood (Moore & Diez Roux, 2006). Another reason it is important to target dietary habits at an early age is because food preferences and the development of dietary habits can begin as early as the first year of life (Birch & Fisher, 1998).

Although substantial work is going into programs that focus on weight reduction and obesity treatment, there are also major efforts being put toward preventing the development of weight problems. Some of these preventive efforts are primarily focusing in on children with the goal of instilling healthy dietary and lifestyles habits. Part of this effort is to target the weaknesses in the diets of children, particularly those from Hispanic populations, as toddlers in this ethnic group already have a high prevalence of overweight. Therefore, this thesis will focus on the issue of how sugar-sweetened beverages are affecting the overall diet and weight status of children within the low-income Hispanic population.

II. Review of the Literature

Health professionals have begun to advocate for a reduction in sweetened beverage consumption among adults and children. The Department of Health and Human Services along with the Centers for Disease Control and Prevention have published a report that outlines how and what to do to help prevent obesity in the United States (Khan et al., 2009). One of their key messages states that communities should take on the challenge to limit unhealthy food and beverage advertisements and disfavor sugar sweetened beverage consumption (Khan et al., 2009). The exposure that children receive to food advertisements has increased over the years (McNeal, 1999; Ziegler, Briefel, Ponza, Novak, & Hendricks, 2006). There have been efforts to control how much exposure children get to food and beverage advertisements. The Children Food and Beverage Advertising Initiative was started by the food and beverage industry in 2006 to make the industry more responsible about what and how often children see food and beverage advertisements on television. Recently this initiative was evaluated for its efforts to self-regulate. It was found that two-thirds of all advertisements on televison aimed at children were foods and beverages that should only be considered for consumption on special occasions (Kunkel, Wright, & Children Now.org). There is still a lot to be done but the efforts have at least begun to move in the direction favoring better nutrition for children.

Over the years the consumption of calories from sweeteners has increased and this trend could continue to rise. Between the years 1977 and 1996 there was an overall increase of 83 calories ingested per day from caloric sweeteners among Americans two years and older. Of these 83 calories, it is estimated that soft drinks contributed 54 calories and fruit drinks contributed 13 calories (Popkin & Nielsen, 2003).According to the Economic Research Service (ERS) 2010 database provided through the U.S. Department of Agriculture, the food availability of milk has steadily been decreasing since ERS started collecting food availability data in 1970 (Economic Research Service, 2010). Along with this steady decrease in milk availability, carbonated soft drink availability has consistently stayed above milk for each respective year. In 1980, when ERS began collecting data on carbonated beverages, total milk availability in gallons per capita was 27.56, and the total carbonated soft drink availability in gallons per capita was 33.63. The most recent data from 2007 shows that total milk availability in gallons per capita was reduced to 20.7, and total carbonated soft drinks in gallons per capita has risen to 48.8 (Economic Research Service, 2010). Given this shift in the food supply (availability), it is evident that the demand for carbonated soft drinks is higher than for milk. For 2007, in addition to the carbonated soft drink availability, fruit juices, fruit drinks, fruit cocktails and flavored "-ades" add another 21.12 gallons per capita per year to the availability of non-milk beverages. Therefore, it is no surprise that in recent years non-milk beverage consumption among children and adults has been targeted as a potentially detrimental dietary component that could be contributing to the overall obesity epidemic.

The concern of added sugars in the diet: Health and nutritional consequences

Among adults and children, the intake of sweetened beverages has been linked to an increased intake of calories and an increased the risk of becoming obese (Wang, Bleich & Gortmaker, 2008). According to one of the more recent studies on beverage intake, non-diet beverage intake among Americans has increased total daily energy consumption by 150-300 calories compared to 30 years ago (Nielsen & Popkin, 2004). In a longitudinal study done with girls from age 5 years to 15 years, it was found that even when controlling for 24-hour energy intake, sweetened beverage intake at age 5 resulted in a positive and significant predictor of adiposity at all subsequent measures taken at ages 7, 9, 11, 13, and 15 (Fiorito, Marini, Francis, Smiciklas-Wright, & Birch, 2009). Sweetened beverage consumption is a major concern because of its potential to contribute to the overall added sugar levels in an individual's diet (Bachman, Reedy, Subar, & Krebs-Smith, 2008). Studies have shown that diets, among adults with high added sugar levels, are associated with a low-nutrient density profile in their diet compared to adults that have low levels of added sugars in their diet (Marriott, Olsho, Hadden, & Connor, 2010; Thompson et al., 2009). Children are also affected in the same way.

The main concerns with the beverage intake patterns among children have to do with recent findings showing that milk consumption is currently decreasing while sweetened beverage consumption is increasing (Borrud, Wilkinson, & Mickle, 1997; LaRowe, Moeller, & Adams, 2007; Marshall, Levy, Broffitt, Eichenberger-Gilmore, & Stumbo, 2003; Skinner, Ziegler, & Ponza, 2004). Many of the questions being studied pertain to how this pattern may be affecting the overall diet quality among children. Currently, the American Academy of Pediatrics recommends that children age 1 to 6 years consume no more than 4 to 6 ounces of 100 percent juice per day (Kleinman, 2009). However, many studies focusing on beverage intake trends among children are finding that adherence to this recommendation is low among those who consume sweetened beverages (Briefel, Reidy, Karwe, & Devaney, 2004).

One of the main objectives in studying beverage intake among youth age groups is determining if there is a relationship between sweetened beverage intake and weight status. This is an important objective as excessive weight issues can lead to the development of hypertension, sleep apnea, diabetes mellitus and cardiovascular disease (e.g., metabolic syndrome) (Zimmet et al., 2007). In 2001, Ludwig, Peterson, and Gortmaker (2001) published a paper on a two-year prospective, observational study with school-aged children (mean age 11.4 years, n=548) looking at how changes in sweetened beverage consumption affected their BMI and the incidence of obesity from baseline to follow-up. They found a positive relationship between BMI taken at follow up and the change in sweetened beverage consumption from baseline to follow up. They also found that each additional intake of 1 glass or can of sweetened beverage per day increased the odds of becoming overweight by 60 percent (Ludwig et al., 2001).

There are few studies done with toddlers and infants in terms of beverage intake and its impact on weight status, however, there are still some being done. A study by Welsh et al. (2005) looked at how weight status was associated with sweetened beverage consumption among low-income preschool-aged children. They found that preschoolers who were already at risk-for-overweight at baseline and consumed 1 to 3 or more sweet drinks per day (sweet drinks were defined as any naturally sweetened or sugar sweetened drink) were 2 times more likely to become overweight compared to the preschoolers who did not consume sweet drinks. Most importantly, this study found that children who consumed more sweetened drinks daily, also had a reported higher energy intake compared to the children that had 0 or 1 sweetened drink per day. In a different study that recruited children at 1 to 5 years-old and followed them a year later, it was found that fruit juice intake among participants that started off as at-risk for overweight or overweight (defined then as ≥ 85th or 95th percentiles, respectively) showed a greater association with excess adiposity gain at follow-up than children who were initially classified as normal weight (Faith, Dennison, Edmunds, & Stratton, 2006). The authors of this study suggest that groups that are at an increased risk for becoming obese (i.e., based on obesity prevalence data or genetics) should be targeted for reducing juice consumption given the increased risk it has on becoming overweight even among toddlers.

It is difficult to find that sweetened beverage consumption causes weight gain among children of preschool age but perhaps that is not the aim. O'Connor, Yang and Nicklas (2006) found in their study that children 2 to 5 years of age who consumed more than 6 ounces of sweetened beverage per day also had a high energy intake when compared to the children who consumed less than 6 ounces per day. However, they found no significant relation between the amounts of sweetened beverage consumed or the type of sweetened beverage with body mass index (BMI). It is theorized that the reason it is difficult to find an association between high energy intake due to sweetened beverages or even other foods and BMI for this age group could be due to an early onset (before the age of 5) of adiposity rebound (AR) which manifests itself as a low BMI at first and then an increased BMI after the adiposity rebound. Adiposity rebound is defined as "The age at which body mass index (BMI) increases after its nadir in childhood" (Dorosty, Emmett, Reilly, & ALSPAC Study Team, 2000, p. 1115). Early adiposity rebound is becoming common among new generations and it is of concern because it has been found to be prevalent among adolescents that have become overweight (Rolland-Cachera, Deheeger, Maillot, & Bellisle, 2006). It has also been shown that "children undergoing early AR gained fat at a faster rate than children who reached adiposity rebound at a later age" (Taylor, Goulding, Lewis-Barned, & Williams, 2004, p. 1228).

Given the issues concerning AR and finding an association between energy intake and BMI with preschool children, there is still the concern with the quality of the diet among this age group. In a study by Harnack, Stang and Story (1999), it was found among preschool-aged children that those who consumed between 0.1 to 8.9 or more ounces of soft drinks per day over a 2-day diet recall had a significantly lower average intake of calcium in their diet than those who consumed zero ounces of soft drinks. Non-consumers of soft drinks yielded an average intake of 722.0 milligrams of calcium; consumers of 0.1 to 8.9 ounces yielded an average intake of 635.2 mg of calcium; and those who consumed 9 or more ounces of soft drinks had an intake of 527.6 mg per day (Harnack et al., 1999). The 2005 Dietary Guidelines for Americans recommend that pre-schoolers aged 2 and 3 get at least two cups worth of dairy, the equivalent of 551.44 mg of calcium in their daily diet (U.S. Dept. of Health & Human Services, Dept. of Agriculture & Dietary Guidelines Advisory Committee, 2005). Though this requirement was met for the most part in these studies, the findings show that as children get older and their calcium recommendations increase, they are following a pattern that threatens adherence to their calcium recommendations.

Among studies done with infants the same concern for milk intake has been seen. In the Feeding Infants and Toddlers Study (FITS), Skinner et al. (2004), looked at subjects from 4 to 24 months and found that the older the infants got the less milk they consumed, which was paralleled by a higher intake of juice drinks, 100 percent juice, and carbonated drinks. A negative relationship was also detected between 100 percent fruit juices, fruit drinks, and carbonated beverages and the calcium density of the diet among the FITS subjects. That is, the more sweetened beverages they consumed, the lower their calcium intake as determined through their diet recall analysis. Skinner et al. also concluded that 100 percent juice consumption was double the amount at 19 months of age, 9.5 ounces, compared to an average of 4.1 ounces of intake at 4-6 months of age. Another investigation using data from the Iowa Fluoride Study (IFS) found that infants 16 months of age or older began to decrease their overall milk consumption and started to increase their 100 percent juice and juice drink consumption (Marshall et al., 2003a). In a study using NHANES 2001-2002 data (LaRowe et al., 2007), it was found that children age 2 to 5 years who drank primarily fruit juice beverages compared to the other groups (mixed/light consumers of drinks, high-fat milk consumers, and water consumers) had the worst score for vegetable intake and also had the highest intake of calories per day as measured by the Healthy Eating Index (HEI). Of the 100 children 6 to 11 years of age who consumed primarily sweetened drinks compared to other beverage types, 35 percent of them were overweight (BMI percentile ≥ 85), had the highest recorded time of "media screen time" per day (e.g. watching tv, playing video games), shown to be associated with low physical activity, and also had the highest intake of calories per day (LaRowe et al., 2007). These findings of dietary associations between a low vegetable score on the HEI and the type of beverage mostly consumed could be detrimental to the overall health of a child. Both the FITS and IFS studies suggest that high consumption of fruit juice, sweetened drinks and soda are a concern because of their association with a low household income, a low HEI, and high calorie consumption.

Patterns and observations seen during infant and toddler years could have the potential to continue on throughout life. Nielsen and Popkin (2004) looked at beverage intake from 1977 to 2001. In their study, they divided their data by the age ranges of 2 to 18 years, 19 to 39 years, 40 to 59 years, and 60 or more years. They found the 2 to 18 year group, an age group in which calcium intake recommendations are high, had the largest decrease in milk consumption of all the other age groups (Nielsen & Popkin, 2004).

It is important to determine specifically at what ages or how early in life diet can be targeted to prevent unwanted dietary habits that negatively affect overall health among people. Studies have found that food preferences developed early in life can largely influence dietary preferences throughout the life span unless one makes a concerted effort to change those preferences (Birch, 1999). If given the choice between plain milk and juice, for example, children will probably choose the latter as humans are predisposed to the preference for sweet tastes (Birch, 1999; Fox, Pac, Devaney, & Jankowski, 2004). It is the further development of a preference to very sweet that should be avoided during childhood as this preference could strengthen throughout life (Mennella, Griffin, & Beauchamp, 2004).

Consumption of energy-dense non-milk beverages is not only a concern for weight gain and adequate nutrient intake among children but is also relevant for oral health. Preventing oral health problems at an early age by instilling healthy dietary and lifestyle habits among children can also prevent added costs pertaining to dental healthcare (Marshall et al., 2003b). It has been found that children who are overweight ($\geq$ 85^{th} weight/length percentile) or are obese ($\geq 95^{th}$ percentile) have a higher prevalence of cavities than children who are below the 85th percentile according to their growth charts (Marshall, Eichenberger-Gilmore, Broffitt, Warren, & Levy, 2007; Reifsnider, Mobley & Mendez, 2004). The recommendation to reduce sweetened beverage consumption among children of all ages can therefore help reduce the prevalence of oral health problems, such as cavities, in addition to reducing the calorie and sugar consumption in their diets.

Intervention studies and sweetened beverage intake

Although a direct causal relationship has not been established between the intake of sugar-sweetened beverages (SSBs) and being overweight or obese among children, intervention studies conducted with adults and adolescents have found a positive outcome in terms of weight reduction when participants refrain from consuming sweetened drinks. A study by Chen et al. (2009) found that a reduction of SSB intake of 12 ounces per day was associated with 0.5 kilograms of weight loss at 6 months and then further with 0.7 kilograms weight loss at 18 months as compared to baseline values for adult participants. For all groups in the study, the average weight loss at 6 months was 3.5 $\pm$ 5.2 kilograms and at 18 months was 3.0 $\pm$ 6.1 kilograms (Chen et al., 2009). As the authors expected, those with a higher BMI experienced greater weight loss compared to the other participants when they reduced calorie consumption from SSBs. In a randomized control intervention study called Beverages and Student Health (BASH), subjects aged 13 to 18 years were recruited to test the effect on BMI by substituting an alternative diet option for sweet beverage drinks for the duration of 25 weeks (Ebbeling et al., 2006). Participants in the intervention group (n=53) who had a BMI of 25.6 or greater at baseline (considered overweight) had a significant reduction in BMI at the end of the 25 weeks (-0.63 $\pm$ 0.23 kg/m^2) when compared to the control group (n=50) (+0.12 $\pm$ 0.26 kg/m^2).

Any reduction in calories sustained for a long period of time, as it was done in the previous studies, can be expected to result in some magnitude of weight loss. If calorie consumption decreases, and nothing else changes in the subjects' lifestyle, their net energy balance (which equals energy consumed plus energy expended) naturally decreases, thus the weight loss over time (Wardlaw & Hampl, 2007). Since, sweetened beverages provide no additional health or nutrient benefit that cannot be met by consuming a healthful balanced diet, reducing the consumption of sugar-sweetened beverages may be an ideal way to prevent overconsumption of calories and added sugar intake.

The concern for overconsumption of calories: Liquid calories, and their effect on satiety

Data from the Continuing Food Consumption Survey II (CFCS) shows that consumption of calories in liquid form has increased over the years, with most of the increase being attributable to non-milk type beverages (Borrud et al., 1997). What does this have to do with the obesity problem? Calories in liquid form are of utmost concern given their inability to induce satiety alone (Flood-Obbagy & Rolls, 2009). Weight maintenance can be influenced by many factors, but generally one can achieve energy balance through diet and exercise, or maintain a steady intake of calories from day to day (Spiegelman & Flier, 2001). Consuming sweetened beverages throughout the day during and in between meals could potentially lead to the overconsumption of calories since energy compensation is low when consuming liquid calories (Flood-Obbagy & Rolls, 2009; Mattes, 1996; 2006). This is one of the reasons why frequent and high consumption of calories in the form of liquids could easily put a person at risk for overweight or obesity. It is theorized that the lack of satiety provided by liquids could be due to their fast emptying from the stomach to the gut and then a fast transit time through the gastrointestinal tract (Flood-Obbagy & Rolls, 2009; Mattes, 2006).

Given that studies use different methods of assessing how calories in liquid form influence satiety and therefore subsequent food intake, the evidence is inconclusive as to whether the intake of calories in the form of liquid predispose a person to the overconsumption of daily calories or if liquid calories actually help provide more satiety. Beverages that are not nutrient dense or are considered clear liquid drinks provide the least satiety and therefore can potentially have the most impact on the overconsumption of daily calories (Mattes, 2006). DiMeglio and Mattes (2000) found in their study with adult participants that those who were given solid loads to consume on a daily basis for 28 days reported lower energy intakes according to a comparison between their baseline diet recalls and the diet recalls obtained during solid load treatment. Those participants who were given liquid loads to consume for the 28 day treatment period were found to have increased their energy intake mostly due to a lack of satiety from their liquid load intake. Almiron-Roig, Flores and Drewnoski (2004) conducted a similar study in which participants were given cookies as the solid pre-load or cola as the liquid pre-load 2 hours before their meal or 20 minutes before their meals. They found that the type of preload, solid or liquid, did not make a difference in their energy intake during the meal but that what did make a difference was the time proximity to the meal in which they consumed the preload. Consuming the preload at 20 minutes prior to the meal decreased the amount of food consumed during that meal. This study, however, did not collect baseline dietary intake data. In a study by Dubois, Farmer, Girard, and Peterson (2007), they found pre-school aged children that consumed sugar-sweetened beverages between meals were found to have an increased risk for being at-risk for overweight ($\geq$85th percentile) or overweight ($\geq$ 95th percentile), now defined as overweight or obese, respectively.

High-fructose corn syrup: The potential impact on metabolism

Media hype has centered in on the abundance of high fructose corn syrup (HFCS) in many of the processed food products on the market. HFCS can come as a mixture of 42 % fructose and the rest as glucose or as much as 55 % fructose and the rest as glucose (Bray. Neilsen, & Popkin, 2004). Sucrose, more commonly known as sugar, is a disaccharide made up of two monosaccharides- fructose and glucose (Stipanuk, 2006). Thus, the composition of HFCS and sucrose are very similar. The difference is in the percentage that is composed of only fructose, where sucrose is a disaccharide and breaks down to 50% glucose and 50 % fructose (Stipanuk, 2006). Because of this issue it is difficult to pinpoint the consumption of HFCS as one of the culprits for the obesity epidemic since it is abundantly found in our foods as a mixture of glucose and fructose.

Research has shown no significant difference between the consumption of foods with HFCS or with sucrose, and how they affect overall energy consumption and endocrine and metabolic responses (Melanson et al., 2007). However, it has been shown that when a high fructose (no glucose) meal is given, there is no suppression of the hormone grhelin, which induces hunger, and no secretion of leptin or insulin, which are important signals of energy regulation for the central nervous system (Teff et al., 2004). Given the metabolic process brought on by the consumption of fructose in large doses, the concern is that because HFCS can be found in almost all processed foods, it could amount to a high intake of fructose throughout the day. Food companies in the United States have primarily switched over to using HFCS since it was first introduced into the food supply in the 1960s as the main sweetener for many packaged products, thus the consumption of fructose has increased (Bray et al., 2004; Putnam & Allshouse, 1999). However, it is difficult to single out fructose when it is also being consumed along with glucose, which does induce favorable metabolic and endocrine responses.

Therefore, for this thesis, the concern with SSB is not so much what type of carbohydrate is being consumed, but more so if energy-dense foods in the form of liquid play a role in the over consumption of daily calories when compared to subjects that do not consume sugar sweetened beverages. There have been relatively few studies conducted where beverage intake among infants has been examined. The 2002 Feeding Infants and Toddlers Study (FITS), as mentioned previously, is one of the foremost recent studies done on infant nutrition and energy intake. What makes the present study different from the FITS is that low-income Hispanics will be specifically targeted. Although the FITS study targeted a nationally representative sample, only 12% of their sample was of Hispanic origin and most of their households were comprised of middle-class status families (Devaney, Ziegler, Pac, Karwe, & Barr, 2004).

Summary and Hypotheses

It is important to investigate dietary intake among populations that are at greatest risk for health problems such as those related to obesity. Research has shown that food preferences can develop as early as the first year of life. Studying dietary intake among low-income Hispanic infants and toddlers in the United States is a pressing issue as children of this age group and population currently have the highest prevalence for overweight (Sharma et al., 2010). Sweetened beverage intake (excluding sweetened milk) has received a lot of attention from pediatricians, dentists, and nutrition experts and scientists because of how pervasive it is in our food supply, how damaging it can be to oral health, and because of its energy density. For this reason, dietary intake related to beverage type intake (sweetened versus non-sweetened beverage consumers) among Hispanic 12-month old infants will be examined for this thesis project.

Given the increasing availability and variety of sweetened beverages, it is hypothesized that participants in this project are exceeding the 4-6 ounce daily allowance for 100 percent fruit juice as recommended by the American Academy of Pediatrics for children aged 1- to 6-years-old (Kleinman, 2009). It is also expected that the participants will be exceeding their estimated energy requirements, especially among those subjects who are consumers of sweetened drinks. Given all this, it is further hypothesized that there will be a higher weight-for-length percentile and a higher consumption of calories among those that consume sweetened beverages. The literature on dietary intake among Hispanic toddlers and infants is scarce and therefore the results of this project can add to the understanding of obesity risk factors among this ethnic age group in order to help prevent poor dietary habits, which can lead to various types of health problems.

III. Methods

Subjects

Subject data for this thesis was obtained through the Rutgers Infant Nutrition and Growth Project (RING), a National Institute of Child Health and Human Development-(NICHD) funded investigation of the correlates of infant growth. This project enrolls low-income minority mothers soon after the birth of their infant with breastfeeding as one of the main exclusion criteria for participation. It aims to track infant development longitudinally from birth to 5-years, collecting information on anthropometrics, dietary intake, feeding issues, and maternal perceptions of infant temperament. Approval for the RING Project was obtained through the Human Subjects Institutional Review Board (IRB) at Rutgers University. Participants in the RING Project are mothers and their children who were recruited from the Special Supplemental Nutrition Program for Women, Infant, and Children (WIC) program in New Brunswick, New Jersey. Services provided through WIC are made available to all families regardless of race that have either no income or have a household income that does not exceed 185% of the United States Federal poverty guidelines (United States Dept. of Health and Human Services, 2009; WIC lncome Eligibility Guidelines, 2009). Given the economic background of WIC participants, all participants recruited for the RING Project are from low-income household families. Written informed consent in Spanish where appropriate (Informed consent form, Appendix A) also obtained for each mother-infant participant. During the recruitment process, each mother was informed that, with their continued consent, visits would occur in their home at 3 months, 6 months, 12 months, and once a year thereafter in proximity to the child's birthday until the age of 5. Only data from the 12-month infant home visits were used for this thesis, as well as the recruitment information obtained at time of enrollment in the RING Project. The mothers in this study were from Mexico (n=79), Dominican Republic (n=12), Peru (n=6), Puerto Rico (n=6), Honduras (n=4), Colombia (n=3), and Nicaragua (n=1).

Data collection and home visit procedures

Specific data used from the RING Project database was demographic information, infant birth information, anthropometric data at 12 months, 24-hour diet recalls at 12 months and maternal demographics and anthropometrics obtained during enrollment. Only subjects of Hispanic ethnicity were used for this subsample. Home visits were conducted in pairs from the RING project staff who were certified by the Rutgers Institutional Review Board (IRB) for human subject research. Every home visit consisted of two consecutive days of data collection. In addition, due to the demographic background of our participants at least one home visitor was required to be fluent in Spanish.

Day 1

On Day 1 of the home visit each infant was weighed in kilograms using a portable infant scale and measured recumbently in centimeters with a tape measure from the head to heal of the infant. This anthropometric data was recorded on the home visit report form (Appendix B). Mothers were asked about the baby's behavior during the previous 24 hours as to whether her infant had been sick or exhibited atypical behavior. These questions were asked to ensure that data collected would be as representative as possible of a typical day. This information was then recorded on the same form. Whether the baby had been sick or exhibited atypical behavior along with obtaining any input from the mother, the 24-hour diet recall was still collected.

Before commencing with the diet recall, the mother was asked with respect to the infant's food intake, if the past 24 hours represented a typical day for them. Their response, either 'yes or no', was recorded on the 24-hour diet recall form (Appendix C). The home visitors then proceeded with collecting the diet recall. The mother was asked to recall from the day before what the baby had eaten until the present hour of the home visit. Alternately, the mother could start with what the infant ate most recently and go backwards from there. The order in which food intake was recalled from the last 24 hours did not matter as long as 24-hours were accounted for and the entry on the diet recall form followed the order in which it was eaten. The approximate time of the day foods were eaten was also recorded, however if the mother could not remember the exact time, the food item was still recorded on the diet recall form. If it was determined that the mother had too much difficulty in remembering what their baby ate in the past 24-hours on day 1 or day 2, it was not pushed any further so as to not make the mother feel obligated to report some kind of food intake. Food models (Appendix D) and visual aides (Appendix E) for estimating portion sizes were used as needed to increase accuracy of the estimates of amounts of food served and consumed by the baby. In each instance where the mother mentioned how much food was served, the home visitor was instructed to ask if everything that was served or fed to the infant was ingested. All food intake data was recorded on the 24-hour diet recall form along with any comments made by the mother and notes made by the home visitor (Appendix C).

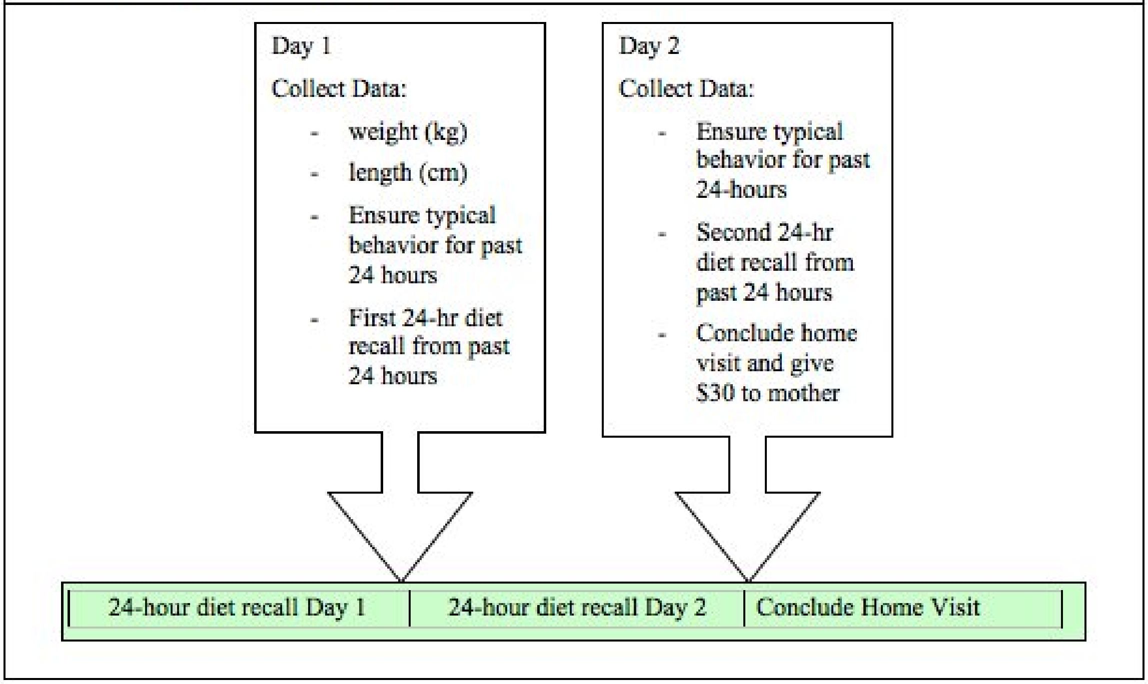
At the conclusion of the first day, the home visitors reminded the mother that they would return the next day at the same time and to call if there were any concerns or conflicts. The home visitors made sure to advise the mother to keep in mind what the baby would eat over the following 24 hours. Given the educational level of the study participants, the dietary recall forms were not left with the mother so as to not risk offending anyone who might be illiterate or experience embarrassment because of difficulty in understanding how to fill out the form.

Day 2

During the second day of data collection, the question concerning if the infant had a typical day in the past 24 hours was again asked (i.e. the time from when the home visitors left the home the first day to the time they arrived on the second day). This information was then again recorded on the home visit report. After noting if food intake had also been typical or not in the past 24 hours, the home visitors proceeded with collecting the food intake for the 24-hour diet recall. Again, food models and visual aides were used if necessary to aid the mother in estimating how much food their baby had consumed. Figure 1 shows a general outline of the protocol for each 2-day home visit conducted. At the end of the two-day home visit, each mother or caregiver that participated was compensated with a $30 payment for participation in the study.

Each home visitor was instructed to always obtain 2 days worth of diet recall; however, obtaining one day of diet recall was still deemed sufficient. Inclusion or exclusion of the diet recall data for this study would be determined at the time of dietary analysis in the lab.

Figure 1. 2-day home visit protocol.



Beverage intake data was obtained from all 24-hour (1-day) or 48-hour (2-day) diet recalls collected. Two-day diet recalls were averaged to a1-day diet assessment. Beverage data was transferred onto a separate sheet, the Beverage Log (see Appendix F), to ease the calculation of total calories that contributed to the overall calorie consumption from each beverage consumed for each subject and to ease input into the database. Beverages were categorized into plain cow's milk (all participants consumed whole milk), plain formula, sweetened cow's milk, 100 percent juice, and juice drinks. A category for sweetened formula was also created but no subjects in this cohort reported any such intake in their diet recall. Sweetened cow's milk was defined as milk already artificially flavored, or any plain cow's milk that was mixed with chocolate or strawberry flavoring in the form of powder or syrup. One hundred percent juice was determined based upon what brand of juice was consumed or if it was obtained with WIC vouchers at the supermarket or convenience store (WIC only allows for the purchase of 100 % juice with their vouchers). Juice drinks were defined as anything not known to be 100 % juice, or brands known to be fruit cocktails, "-ades", and punches indicated on their label as less than 100 % or only a certain percentage of fruit juice. Nutrition facts labels were obtained by means of visiting local convenience stores or bodegas for products not known to any study research assistants in order to determine if it was 100 % juice or a juice drink.

For anthropometrics, weight was measured in kilograms and height was measured in centimeters from the top of the head to the heel of the foot as per standard measuring technique for infants. Both measures were plotted onto a gender specific infant growth chart to calculate weight-for-age and weight-for-length growth chart percentiles (see Appendix G (female) and Appendix H (males) for CDC Gender specific growth charts) (Centers for Disease Control and Prevention, National Center for Health Statistics, 2000).

Maternal and infant demographic and anthropometric characteristics

Maternal demographic and anthropometric characteristics were obtained at their time of enrollment into the Rutgers Infant Nutrition and Growth (RING) Project. Pre-pregnancy and gestational measures for the mother such as their pre-pregnancy Body Mass Index (BMI, a ratio of weight in kilograms to height in meters squared) and birth information were specifically obtained from the WIC client database, the location at which they were also recruited.

As previously mentioned data was then analyzed by group status, non-SSB or SSB, and further by weight for length status.

Statistical Analysis

Before data was analyzed, each diet recall that was completed on a home visit by a research assistant on the RING Project and each beverage log completed in the lab was reviewed to ensure accuracy. Complete data was then entered in the SPSS database for this thesis study. Data for 165 subjects were available at 12 months, however, only a total of 111 subjects at 12 months were included for this study based on completed 24-hour diet recalls (n= 136) and having a Hispanic ethnicity(n= 111). Diet recalls that were deemed incomplete (e.g. indicated as an atypical day on the diet recall form) were excluded from this thesis study.

Subjects in the study were split into non-sugar sweetened beverage (non-SSB) consumers and sugar-sweetened beverage (SSB) consumers based on the entries on their diet recall forms. Data was then analyzed by group status of the infants. The consumption of one sweetened drink of any kind per day was enough criteria to include a subject in the SSB group. Non-sugar-sweetened beverage consumers were defined as those who only consumed plain milk, formula or water based on their 24-hour diet recall. Subjects were also further grouped by their weight for percentiles by age and gender specific growth charts. For the purpose of this study, subjects with a weight for length percentile less than the 85th are classified as normal weight and subjects with a percentile of 85 or higher are considered overweight (Centers for Disease Control and Prevention, Use and interpretation of CDC growth charts, 2007). Participants with a weight for length percentile below the 85th were therefore compared to those subjects with a weight for length percentile higher than the 85th.

Estimated energy requirements (EER) were also calculated for each individual subject in the study using an age-specific EER formula and inputting that into SPSS. The equation used to calculate the estimated energy requirement was age-specific for infants 12 months of age. The equation used was as follows: Estimated energy requirement (EER) = (89x weight [kg]) – 78 (Wardlaw & Hampl, 2007). EER requirements were not split by gender as there were no significant differences between them. According to Butte (2005), energy requirements for breastfed 12-month-old infants are 788 kilocalories per day for boys and 729 calories per day for girls. Dietary Reference Intakes (DRIs) as set by the Institute of Medicine (IOM) were used to compare mean nutrient intakes among subjects in this study (Institute of Medicine, & Food and Nutrition Board, 1997a, 1997b). Means and standard deviations were used to show descriptive demographic and anthropometric data, and for dietary data. Differences between groups were assessed by either using independent sample t-test, paired sample t-test, or ANOVA. All analyses were done using SPSS version 16.0. For statistical significance, a p value <.05 was used.

IV. Results

Maternal and infant demographic and anthropometric characteristics are shown in Table 1. When maternal demographic and anthropometric measures data were analyzed between the two groups (non-SSB vs. SSB), no statistically significant differences were found. Anthropometric data at birth and at 12 months for the infant were also tested for differences between the groups, but no statistically significant differences were found.

Table 1. Non-SSB vs. SSB: Maternal and infant characteristics at enrollment – means (standard deviations,SDs).

	All	**Non-SSB**	**SSB**
Maternal	(n=111)	n=44	n = 67
Age (years)	27.1 (5.4)	27.7 (5.5)	26.7 (5.4)
Highest school grade completed	8.6 (3.3)	8.3 (3.3)	8.8 (3.2)
Number of years in US	6.5 (4.5)	6.4 (5.1)	6.6 (4.1)
Pre-pregnancy BMI	26.3 (4.6)	25.7 (3.9)	26.6 (5.0)
Infant - at Birth			
Weight (Kg)	3.3 (0.5)	3.4 (0.6)	3.3 (0.5)
Length (cm)	49.4 (4.9)	49.2 (6.3)	49.5 (3.8)
Weight for Length percentile	50.1 (34.0)	46.8 (35.8)	52.1 (33.0)
Infant - at 12 mos			
Weight (Kg)	10.3 (1.2)	10.3 (1.3)	10.3 (1.2)
Length (cm)	75.1 (4.1)	75.2 (4.0)	75.1 (4.3)
Weight for Length percentile	72.9 (26.8)	75.1 (26.8)	71.4 (26.9)

B. Non-sugar sweetened beverages consumers vs. sugar sweetened beverage consumers

Intake of plain cow's milk and plain formula in fluid ounces were tested for differences between groups. A statistically significant difference ($p < .05$) was detected for both beverages between the groups shown in Table 2a. Non-SSB consumers drank significantly more plain cow's milk or plain formula compared to the subjects who were SSB consumers even though the percentage of subjects consuming milk in the non-SSB group was almost the same as the SSB group.

Table 2a. Cow's milk and Formula intake by non-SSB consumers and SSB consumers at 12 months, means (SDs), (n=111).

	Non-SSBs*	**SSBs****		
	n=44	n=67	*t* value	*p* value
Cow's milk (%)	68	69		
fl.oz/day	27.03 (16.23)	20.55 (11.33)	-2.05	0.04
Formula (%)	34	22		
fl.oz/day	24.13 (10.54)	16.67 (9.57)	-2.03	0.05

*Non-SSBs- subjects who drink only milk/formula or water, no other beverage consumed

**SSBs- subjects who consume all beverages listed.

Among the SSB consumers, 100 % juice consumption and juice drink consumption separately did not exceed the 6 fluid ounces show in Table 2b. Even when both 100% juice and juice drink intake were added together mean juice consumption still did not exceed 6 ounces.

Table 2b. Sweet milk, 100% Juice, and Juice drink intake by non-SSB and SSB consumers at 12 months, means (standard deviations)/ day, (N=111).

	Non-SSBs*	**SSBs****		
	n=44	n=67	*t* value	*p* value
Sweet milk (%)		28		
fl.oz/day		16.58 (14.4)		
100% Juice (%)		66		
fl.oz/day		4.53 (2.67)		
Juice-drinks (%)		27		
fl.oz/day		5.06 (3.37)		

*Non-SSBs- subjects who drink only milk/formula or water, no other beverage consumed

**SSBs- subjects who consume all beverages listed.

Differences in total mean calorie intake per day between groups were tested. Mean calories intake and EER were also tested for differences within the two groups separately. Mean calorie intake and mean EER are shown in Table 3. No significant differences were detected between the groups. However, the difference in calories between the groups was 80.6 calories with the SSB group consuming seemingly more calories. The calculation for the estimated energy requirement (EER) was done to check that both groups were not different from each other in their estimated caloric requirements. The difference between the EER and mean kilocalorie intake within the non-SSB group was smaller (112.78) than the difference noted within the SSB group (200.08). However, both differences among groups between their kilocalorie intake and their EER were significantly different at the .05 level of significance.

Table 3. Calorie distribution and EER per day at 12 months, (n= 111).*

	Non-SSBs	**SSBs**		
	n=44	n=67	*t* value	*p* value
Kilocalories	944.48 (294.56)	1025.08 (365.70)	1.22	0.224
EER**	831.7 (111.0)	825.0 (108.6)	-0.275	0.784
EER***	931.0			
t value	2.046	4.442		
p value	0.047	0.000		

* Butte (2005), Energy requirements for boys: 788 kcal/day; girls: 729 kcal/day

** EER- estimated energy requirement (89xWt[kg])-78

*** EER – 50th percentile EER infants 12-24 months from Devaney, Ziegler, Karwe, & Barr (2004)

Nutrient intake differences for carbohydrate, protein, fat, vitamin D, vitamin C, and calcium were also analyzed between both groups to determine any differences between the groups. Table 4a shows the DRIs as published by the Institute of Medicine (IOM) for carbohydrates protein, fat, vitamin D, vitamin C, and calcium for infants aged 12 months to 24 months.

Table 4a. Institute of Medicine Dietary Reference Intakes for infants 12-24 months.

Nutrient	DRI
CHO (g/d)	100 (EAR)[a]
Protein	0.88 g/kg/d
Fat g/d)	ND[c]
Vitamin D ug/day	5.0 (AI)[d]
Vitamin C (mg/d)	15.0 (RDA)[e]
Calcium (mg/d)	500.0 (AI)

[a] EAR - Estimated average requirement

[b] Protein requirements are based on body weight in kilograms. For every kilogram of body weight, the body requires 0.88 grams of protein per day for this age group.

[c] ND - No Data; [d] AI - Adequate Intake; [e] RDA - Recommended dietary allowance

As shown in Table 4b, sugar sweetened beverage consumers had a significantly higher mean intake of carbohydrate in grams in their diet compared to the non-SSB consumers (*p* = .012). The percentage of calories from carbohydrate was also greater for the SSB group, though not significantly different from the non-SSB group. There were no significant differences between both types of beverage consumers for protein and fat intake in grams. The percentage of calories from fat reached a significance difference (*p* = .007) with the non-SSB consumers having a higher percentage. Vitamin C mean intake in milligrams was significantly higher among the SSB consumers (*p* = .002).

Table 4b. Mean (SD) nutrient intake/day at 12 months, (n= 111)

	Non-SSBs	**SSBs**		
	n= 44	n= 67	*t* value	*p* value
% Cals, CHO	48	52	2.375	0.077
CHO (g)	113.37 (40.87)	137.67 (59.20)	2.558	0.012
% Cals, Protein	15.85	15.90	-0.061	0.952
Protein (g)	38.92 (19.36)	40.57 (17.97)	0.461	0.646
% Cals, Fat	36	31	-2.776	0.007
Fat (g)	37.71 (14.74)	35.62 (13.69)	-0.760	0.449
Vit D (ug)	8.92 (4.29)	12.57 (?)	0.41	0.680
Vit C (mg)	44.87 (40.67)	75.30 (54.70)	3.159	0.002
Calcium (mg)	1034.33 (561.06)	936.19 (466.40)	-1.00	0.320

C. Normal weight subjects (< 85th percentile): Non-SSB consumers vs. SSB consumers

Table 5 shows mean fluid ounce intake per day and the percentage of consumers per group for each beverage category for the normal weight infants. It was found among those subjects of normal weight for height by growth chart percentile (< 85th) that those children who drank SSBs consumed somewhat less plain cow's milk than those subjects who did not consume any SSBs (all subjects who drank any cow's milk consumed whole milk type). However, this only approached a statistically significant difference. Subjects in the SSB group also consumed slightly less plain formula, than those subjects who were non-SSB consumers, but the difference was not statistically significant.

Table 5. Subjects <85th percentile,

Beverage intake by type in non-SSB and SSB consumers at 12 months, means (SDs), (N= 59).

	Non-SSBs	**SSBs**		
	n=21	n=38	*t* value	*p* value
Cow's milk (%)	63	67		
fl.oz/day	27.29 (15.04)	19.54 (9.74)	-1.93	0.062
Formula (%)	28.47	28.57		
fl.oz/day	20.08 (9.069)	17.72 (10.18)	-.473	0.643
Sweet milk (%)		26		
fl.oz/day		13.45 (9.26)		
100% Juice (%)		66		
fl.oz/day		4.00 (2.59)		
Juice-drinks (%)		26		
fl.oz/day		4.10 (2.20)		

No subjects consumed formula exclusively, therefore the calories consumed from milk and formula were combined. If formula was being consumed it was accompanied at other instances in their diet recall with plain cow's milk consumption. Table 6 shows the average kilocalories consumed from plain cow's milk or formula, SSBs, total mean kilocalorie intake for 24 hours, and the EER for subjects less than the 85th percentile. Subjects in the non-SSB group consumed nearly 100 more calories from plain cow's milk or formula than subjects in the SSB group, though this difference was not significant. The mean fluid ounce intake for 100 % juice and juice drink for the SSB group did not exceed the recommendations on 100 % juice consumption set by the American Academy of Pediatrics (Klienman, 2009). There were no differences detected between the two groups for total 24-hour kilocalorie intake and EER. A difference in calories from plain cow's milk or formula was not detected but non-SSB subjects got more calories from milk/formula than the SSB subjects.

Table 6. Calorie distribution among normal weight infants at 12 months, (n=59).

	Non-SSBs n=21	**SSBs** n=38	T value	*P* value
Milk/formula Kcals	478.51 (240.66)	381.04 (180.54)	-1.657	.104
SSBs Kcals		113.47 (135.62)		
24hrs Kcals	944.53 (348.59)	973.16 (324.01)	0.316	0.753
EER	797.79 (92.22)	783.86 (88.44)	-0.571	0.570

D. Overweight subjects (≥ 85th percentile): Non-SSB consumers vs. SSB consumers

When only the at-risk for overweight subjects (≥ 85th percentile for weight for length) were analyzed in the same way as the previous normal weight group, the overall mean intake of beverages in fluid ounces was greater, except for formula intake among SSB consumers. Although not statistically significant, non-SSB consumers tended to drink more plain cow's milk or plain formula relative to the SSB consumers (Table 7a).

Table 7a. Subjects ≥85th percentile**-**

Cow's milk and formula intake by non-SSB and SSB consumers at 12 months, (n= 52).

	Non-SSBs	**SSBs**		
	n=23	n=29	*t* value	*p* value
Cow's milk (%)	61	69		
fl.oz/day	29.34 (16.89)	20.76 (12.95)	-1.678	0.103
Formula (%)	39	14		

Although a small percentage of subjects consumed juice drinks (8 out of 29), their fluid ounce intake did not exceed the AAP recommendation of consuming no more than 4 to 6 fluid ounces of 100% juice (Table 7b). Juice drink and 100% juice intake were then combined as one beverage type category, however, given the small number of juice drink consumers, the mean intake still did not exceed 6 fluid ounces (data not shown). Thus, their calorie contribution from their milk/formula intake was significantly higher compared to the SSB consumers (Table 8). However, total kilocalorie intake over 24 hours tended to be higher among the SSB consumers.

Table 7b. Subjects ≥85th percentile**-**

Sweet milk, 100% Juice, and Juice drink intake, means (standard deviations) (n= 52).

	Non-SSBs n=23	**SSBs** n=29	*t* value	*p* value
Sweet milk (%)		31		
fl.oz/day		20.06 (18.6)		
100% Juice (%)		63		
fl.oz/day		5.7 (3.0)		
Juice-drinks (%)		27		
fl.oz/day		6.0 (4.1)		

Table 8. Calorie distribution among overweight infants (≥ 85th percentile) at 12 months (n=52).

	Non-SSBs n=23	**SSBs** n=29	*t* value	*p* value
Milk/formula Kcals	552.00 (242.26)	364.91 (219.37)	-2.837	.007
SSBs Kcals		216.17 (303.31)		
24hrs Kcals	944.44 (243.14)	1093.10 (409.95)	1.536	0.131
EER	875.55 (128.71)	896.24 (95.07)	0.667	0.508

E. Normal weight vs. Overweight subjects

An independent sample *t*-test was performed between the non-SSB consumers and SSB consumers to see if there was a significant difference between their weight-for-length percentiles. No statistically significant difference was found and it was therefore deemed unnecessary to perform further statistics such as regression models to test for relationships between the subjects' weight for length percentile and their beverage and calorie intake data.

Among non-SSB consumers, the normal weight subjects appeared to consume on average slightly fewer calories than the subjects categorized as overweight (≥ 85th percentile) (Table 9). An independent sample *t*-test was performed to check for a significant difference between their average daily calorie intakes, however, none was detected. Although there was a greater intake in calories among the subjects at or above the 85th percentile, their fluid ounce intake of plain cow's milk/plain formula was still less than the subjects below the 85th percentile; however, this was not a significant difference.

Table 9. Subjects <85th compared to subjects ≥ 85th percentile, mean calorie and nutrient intake per day.

	<85th` n=59		**≥85th** n=52	
	Non -SSBs	SSBs	Non -SSBs	SSBs
Plain cow's milk (oz/d)	27.9 (15.04)	19.54 (9.74)	29.34 (16.89)	20.79 (12.95)
Sweet Milk (oz/day)		13.45 (9.26)		20.05 (18.66)
Milk/formula Kcals	478.51 9240.66) *	381.04 (180.54)	552.00 (242.26)	364.91 (219.37)
24hrs Kcals	944.53 (348.59)	973.16 (324.01)	944.44 (243.14)	1093.10 (409.95)
EER	797.79 (92.22)	783.86 (88.44)	875.55 (128.71)	896.24 (95.07)
Vit C	41.13 (36.40) **	71.73 (59.26)	48.8 (43.5)	79.98 (48.71)
Calcium	996.13 (563.16)	842.8 (409.75)	1009.2 (561.0)	1058.57 (513.37)
Vit D	8.16 (4.31)	6.47 (3.02)	9.6 (4.2)	7.43 (4.25)

* For subjects ≥ 85th percentile significantly different at .05 level, t= -2.837, p= .007

** For subjects <85th percentile significantly different at .05 level. Vit C, t= 2.45, p= .017

There were no significant differences between the normal weight and overweight participants for 100% juice intake, juice drink intake, and sweet milk intake. As shown in Table 9, the SSB consumers in the overweight group drank more sweetened cow's milk than the SSB group of normal weight. The SSB consumers below the 85^{th} percentile consumed an average of 13.45 ounces of sweet milk per day, whereas the SSB consumers at or above the 85^{th} percentile consumed an average of 20.05 ounces of sweet milk per day. Although this appears as a stark difference between the normal and overweight group for sweetened milk intake in ounces per day, a significant difference was not detected ($p = .248$) likely due to the small number of sweetened milk consumers.

Within the normal weight group, there was a significant difference detected for Vitamin C intake between the non-SSB and SSB consumers ($t = 2.45$, $p = 0.017$). The SSB consumers had a significantly higher intake of vitamin C. No significant differences between the groups were detected for calcium or vitamin D intake. Among the normal weight group ($<85^{th}$), the face level calcium intake was higher for non-SSB consumers compared to the SSB consumers. In the overweight group, the reverse was true.

V. Discussion

Despite the most recent increase in obesity prevalence data among low-income Hispanic toddlers in the United States, there seems to still be a deficiency in getting the message across populations who are most at risk. Low-income Hispanic toddlers have the highest prevalence for overweight according to their gender-specific BMI percentile, yet the literature is still scarce in studying the dietary intake patterns of low-income Hispanic children in general (Polhamus, Dalenius, MacKintosh, Smith & Grummer-Strawn, 2009). Sweetened beverage intake and its effect on the obesity problem among this age group has also been investigated. However, very few studies have focused on populations that are at greatest risk such as Hispanic toddlers. The obesity statistics among toddlers adds to the importance of conducting studies looking into what children are eating and how early on they are being introduced to certain foods (e.g., energy dense foods like sugar-sweetened beverages). The purpose of this thesis investigation was to look into what types of beverages 12-month-old Hispanic infants were being introduced to and consuming and how that might influence their energy intake and their weight status. In the present study, it was determined that there were more subjects that consumed sugar-sweetened beverages than subjects that did not consume sugar-sweetened beverages as based on their 24-hour diet recall.

It was hypothesized that those subjects that consumed SSBs would have a significantly higher weight-for-length percentile than participants who were who did not consume SSBs. After performing an independent sample *t*-test, there was no significant difference found between the two groups in terms of their weight-for-length percentile, thus, this hypothesis was not. However, it is important to note that 47% of the subjects in this study were at or above the 85th percentile for weight for length. According to the Centers for Diseases Control and Prevention (CDC), at 12 months of age there is no overweight or obese status cutoff percentile. By 24 months of age, however, children can be classified as overweight (≥ 85th percentile but less than the 95th percentile) or obese (≥ 95th percentile) according to their gender-specific weight for height growth chart (CDC, 2007). If subjects are already at or above the 85th percentile for weight for length at 1 year, it is conceivable that they, at least a good portion of them, maintain the same status by 2 years of age on.

Some studies have found that sweet beverage intake does not have an effect on weight status among preschool aged children concurrently or at follow-up, and that when it is detected it is only among children that are already considered overweight at baseline (≥ 95th percentile) (O'Connor et al., 2006; Welsh et al., 2005; Skinner et al., 1999). There is also genetic predisposition and the environment which can affect what the children consume. In a longitudinal study, children at age 3 and then at age 4 who were classified as born at-risk by virtue of having at least one parent with a BMI above 25, showed a higher intake of fruit juice compared to those subjects born as low-risk (Kral et al., 2008). Perhaps parents that are overweight or obese have already developed poor dietary habits and thus expose their children to the same poor dietary habits in addition to the genetic predisposition. Another reason for possibly not detecting an association between sugar-sweetened beverage consumption and weight for length percentile could simply be due to the fact that this age group is too young to observe an effect on weight status (Rolland-Cachera, et al., 2006; Whitaker, Pepe, Wright, Seidel, & Dietz, 1998).

Although findings between an association with sugar-sweetened beverage intake and weight for length percentile were not significant, further analyses were still stratified by non-SSB consumer or SSB consumer in order to observe other differences between these two groups

Non-SSB consumers compared to SSB consumers

Milk, sweetened milk, calcium & vitamin D intake

A descriptive analysis of fluid ounce intake for plain cow's milk, plain formula, sweetened milk, 100 % juice, and juice drinks was run for both types of beverage intake groups. While it was not hypothesized that subjects who consumed SSBs would be consuming less milk than subjects not consuming SSB, it was found that the non-SSB group on average consumed significantly more plain cow's milk than the SSB group. The size of the non-SSB group was smaller in number than the SSB group and percentage-wise there were fewer infants in the non-SSB group that consumed plain cow's milk; however, there were more subjects in the non-SSB group consuming plain formula as well. A study by Ballew, Kuester and Gillespie (2000) found that the type of beverage consumed by children can largely influence the nutritional quality of their diet. In their study, children aged 6 to 11 who consumed fruit-flavored drinks (not 100% juice) showed a negative correlation with milk consumption. Ballew et al. (2000) also found that among 2- to 5-year-old children, each ounce of milk that was consumed significantly improved their likelihood of achieving the recommended intake for their age group for calcium by 37%. Another study found that for pre-school aged children that consumed drinks and non-dairy drinks with added sugar (i.e., juice drinks, soda, iced tea) had a significantly negative correlation with the consumption of non-whole milk (Saelens, Couch, Wosje, Stark & Daniels, 2006). In the present thesis, it was found that non-SSB consumers averaged what appeared to be a higher intake of calcium by 101.6 milligrams compared to the SSB consumers, though not significant. As set by the Institute of Medicine, the Adequate Intake (AI) for calcium for infants 12 to 24 months is 500 milligrams per day (Institute of Medicine & Food and Nutrition Board, 1997a). So the AI level for calcium among this age group was met by all participants in this study. However, those in the non-SSB group, whether classified as normal weight (<85th percentile) or overweight (≥ 85th percentile), still had a slightly higher mean intake for calcium than the SSB consumers.

The most consumed type of milk beverage was whole milk which is expected for 12-month-olds as they do not yet have to transition to low-fat milk. Skinner et al. (2006) reported the same finding in that whole milk was the most consumed type of milk beverage among their 12- to 14-month-old infants. As previously mentioned, they also found among infants 15- to 24-months that the intake of 100% juice, juice drinks, and carbonated beverages all had a negative influence on the calcium density of the subjects' diets. This thesis study did not show the same result, which could be attributed to the age and the size of the sample used for the analyses of the impact of sweetened beverages on nutrient density in the diet. Although this was not hypothesized, descriptive statistics showed all children in this study met the AI for calcium.

Sweetened milk was considered any milk sweetened with strawberry or chocolate syrup or powder flavoring. Studies looking at infants and toddlers have yet to report findings on the consumption of sweetened milk and the impact on weight status and total energy intake. However, the consumption of sweetened milk might not be as pressing an issue as the consumption of juice drinks and soft drinks, which provide little to no nutrients and only amount to added sugar intake potentially contributing to excess daily calories. Sweetened milk consumption in contrast to juice drink consumption would in fact be the better choice. Yet, there should still be some concern for exposing infants to sweet tastes early on especially because it has been found that food preferences can begin during the first year of life.

100 % juice, juice drink and vitamin C intake

On average, 100% juice intake among the SSB consumers did not exceed the AAP recommendation of consuming no more than 4 to 6 ounces of 100% juice, but these infants were very close to consuming an average of 6 fluid ounces per day. This finding did not coincide with the hypothesis that those who consumed SSB would be exceeding the 4- to 6-ounce daily recommendation set by the APA for children ages 1 to 6 years old. Although this recommendation was not exceeded by this group for either the normal or overweight groups, it should be noted that for this study 100% juice and juice drink consumption were not combined. There is the possibility that the SSB consumers exceeded 6 ounces of juice intake since not all subjects exclusively consumed one type of beverage. Some subjects consumed both 100% juice and juice drinks. For these subjects, their intake of 100% juice and juice drink was combined but because very few subjects consumed juice drinks (n=8/111), the mean intake still did not exceed 6 ounces. Juice drink consumption only exceeded 6 ounces when analyzed separately.

In terms of the impact of 100% juice and juice drinks on vitamin C, the SSB consumers had a significantly higher intake of vitamin C than the non-SSB consumers. The RDA for vitamin C among 12- to 24-month-old infants is 15 milligrams per day (mg/d) as set by the IOM (Institute of Medicine & Food and Nutrition Board, 1997b). The mean intake of non-SSB consumers was 46.2 mg/d and for the SSB consumers it was 82.8 mg/d. When stratified by weight for length percentile the mean intake of vitamin C per group did not significantly alter. This shows that even infants who did not consume 100 % juice or juice drinks still met the DRI for vitamin C. Devaney et al. (2004) found that for infants 12- to 24-months-old the mean intake for vitamin C was 91 mg/day. The IOM set the Vitamin C upper limit for this age group at 400 mg/d, therefore, too much vitamin C intake was not of concern.

It is clear that for this study, whether subjects were consuming SSB or not, they still well exceeded the RDA for vitamin C. In the study mentioned previously by Ballew et al. (2000), 100% juice and juice drink intake significantly improved the likelihood of children 2-5 years to meet the recommended intake of vitamin C for their age group. Yet, Faith et al. (2006) found that fruit juice consumption predicted increased adiposity among children born to low-income families. However, this finding was only found among children who were already overweight (≥ 85^{th} BMI percentile < 95^{th}) or obese (≥ 95^{th} BMI percentile) at the beginning of the study. Both findings on improved vitamin C intake and increased adiposity among children related to fruit juice consumption are very important, but increased adiposity is a sure sign that fruit juice intake should not be the only food source for vitamin C or a replacement for whole fruit intake in the diets of children.

Mean daily energy intake

It was found that subjects in the SSB group consumed more daily calories than the subjects in the non-SSB group, however, both groups exceeded the calculated EER values. The difference in mean kilocalorie intake between the groups was 95.9 kilocalories. The difference between their EER and their actual kilocalorie intake was significantly different with their kilocalorie intake being higher than their EER. This finding did support our hypotheses that SSB consumers would exceed their EER, and that SSB consumers would have a higher overall energy intake than non-SSB consumers. This finding adds to the concern that sugar-sweetened beverages, even if they are not displacing milk intake, are adding to the overall intake of daily calories among children. O'Connor et al. (2006) found that among 2- to 5-year-olds, those children with a high intake of 100% juice, juice drinks and soda showed an increase in energy intake. Although the difference in energy intake between non-SSB and SSB consumers was not statistically significant when mean energy intake between the non-SSB consumers and SSB consumers was stratified by their weight for length percentile status, the SSB groups still had a higher energy intake the non-SSB groups with the SSB group at or above the 85th percentile for weight for length having the highest energy intake. It is also important to note that the subjects grouped in the non-SSB groups consumed significantly more kilocalories from plain milk/formula then the SSB groups in both weight status groups and still consumed less total daily calories than the SSB groups.

Although it could not be directly attributed as the reason for the higher mean energy intake among the SSB groups, the total mean kilocalories from 100% juice, juice drinks, and sweetened milk for subjects below the 85^{th} percentile was 119.9 kilocalories and for subjects at or above the 85^{th} percentile it was 206.4 kilocalories. The difference between the non-SSB and SSB consumers below the 85^{th} percentile in terms of their 24 hour energy intake is only 40.7 kilocalories. Among those at or above the 85^{th} percentile, the difference between the two beverage type groups was 172 kilocalories, a much more alarming difference than the one observed for the subjects grouped under the 85^{th} percentile.

As there is a concern for consumption of excess calories due to the low satiety provided by liquids with low nutrient density such as juice drinks, this finding can further support the need for targeting the early introduction of these types of beverages into the diet of infants especially during the first year of life (Birch, 1999). It is important to not forget that infants in the SSB group may also be predisposed or exposed to other factors that influence a greater daily energy intake such as having a parent or parents that practice poor dietary habits or living in an environment where purchasing affordable healthful food is difficult to obtain. However the investigation of those factors was beyond the scope of this study.

Strengths

There are relatively few studies that focus on low-income Hispanic populations, especially among infants. Therefore, one of the major strengths of this study is the contribution to the literature pertaining to this demographic group. Other studies that have reported their findings with regard to dietary habits and observations among infants and toddlers are limited in their ability to provide specific recommendations for a specific population. This study, because of its homogenous cohort of subjects, could potentially help nutrition educators target low-income Hispanic infants and toddlers more efficiently. Another strength of this study is that 24-hour diet recalls were obtained by research assistant interviews in the homes of the mothers therefore reducing literacy as a barrier to participating in this study. Other studies, like the FITS, administered telephone interviews to collect the dietary recall information. Although telephone interviews are rigorously developed and validated, it still limits the kind of sampling that studies using this method can reach especially with regard to obtaining accuracy of maternal recall.

Limitations

The sample size for this study may be seen as a limitation. However, infant research is labor intensive and involves a lot of commitment from the parents and research team members. The recruitment of participants also was also challenging and repeated communication with the mothers was essential in order to set up and complete the home visits with them. Ensuring that home visits were done in pairs by Spanish-speaking research assistants and that mothers could be accommodated for making appointments required extensive pre-planning. For infants, only certain dietary reference intakes have been set by the IOM, therefore, analyses of nutrients compared to DRIs (either Adequate Intakes (AI) or Recommended Dietary Allowances (RDA)) could not be carried out for all nutrients. As such, only a comparison between relevant nutrient intakes for this study and the DRIs could be made. Another limitation is that only Hispanic low-income subjects were part of this study. As much as this was a strength of the study it was also a limitation because these findings can only be applied to 12-month-old infants from low-income Hispanic families. Unfortunately, not all home visits conducted went as per protocol and not all research assistants were able to collect 2-day 24-hour diet recall data. One day of diet recall was deemed as sufficient to in this study; however, this might have limited the variation that could be accounted for in the daily dietary intake among infants. Lastly, some participants were lost from the time of recruitment to the actual completion of the 2-day home visit at 12-months leaving fewer participants to actually collect data from.

Conclusion

Recent research has focused on identifying what foods are readily available and affordable to low-income populations. As mentioned previously, studies have found that healthy food options are often more expensive in disadvantaged neighborhoods than in more affluent neighborhoods. Pre-packaged energy dense foods are more readily available and far less expensive making it easier to consume too many calories with a small amount of food. Beverages continue to be of concern because of their vast availability in many types of stores and their range in price. With so many food companies advertising a new health benefit or a new flavor with 100% juices, juice drinks and "-ades" it is difficult to expect consumers to refrain from being persuaded to consume a new beverage.

It is clear from this study that infants who are consumers of juice drinks, 100% juice, and sweetened milk simply consume more calories than infants who do not. Is it the palatability and sweetness that makes them want to consume more? Or as Menella et al. (2004) indicated, does the soothing and analgesic effect of a sweet taste for the baby convince parents to continue offering sweet beverages and foods to their infant because it elicits a positive response? All of these are possible factors that could be attributing to the overconsumption of calories from sugar-sweetened beverages and other sweet tasting foods. Yet, the evidence is still not conclusive enough to say that sugar-sweetened beverages cause overweight or obesity. Despite that, it might not even be so much that researchers and nutritional scientists want to find a direct link between the two. The goal could be to relay to consumers the message that it is harder to compensate for energy intake when it is consumed in liquid form, and even when consumed along with a meal it could be displacing the intake of more nutrient dense foods.

Given these findings, future studies should aim to prevent loss of subjects due to factors such as the mother or caregiver not always providing sufficient detail or recall for collecting dietary intake and consequently being able to analyze the diet recall with accuracy. Or perhaps, with the data and limitations found in this study, future studies should aim to develop a more adaptive 24-hour diet recall that caters to working with a low-literacy population. Perhaps it can be something they can keep at home to fill out to make it easier to account for more days of dietary intake. Although it would seem advisable to have more variety in the food models available for home visitors to use during the home visits, too much variety might let the mother simply agree to food intake prompted by what the food models are showing. In no way should the use of food models influence what the mother recalls as the food ingested by the infant therefore for this study only a few general food models were used. Visual aides for food portion sizes were extremely helpful and future studies should continue to make use of them especially among a low-literacy population. More than 2 days of dietary intake should also be obtained in future studies although the challenge lies in what this type of subpopulation demands of the researchers in order to obtain accurate and complete data. In all, the results and conclusions determined from this study can also not only aid the improvement of future studies similar to this one but also help in directing more focused and targeted nutrition interventions and nutrition education initiatives among low-income Hispanic populations.

VI. References

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VII. Appendix

Appendix A*: Informed Consent Form to Participate*

Informed Consent Form
Project Title: Rutgers Infant Nutrition and Growth Project
Principal Investigator: John Worobey, Ph.D.

You are invited to participate in a research study that is being conducted by Dr. John Worobey, a professor in the Nutritional Sciences Department at Rutgers University. The purpose of this research is to look at growth patterns among 100 infants and children and to see how these relate to levels of activity and food intake. The information collected in this research will help us to better understand the growth and development of children like yours. This letter contains information about the study and the conditions of your participation.

Participation in this study will involve the following:

1) Allow us to visit you at home for about an hour three times during the first year of age of your child (at 3, 6 and 12 months), and one time when s/he is 2, 3, 4 and 5 years of age.
2) Let your child wear a tiny computer the day of the visit and keep it on his/her leg for one day. This computer keeps a record of your child's leg movements.
3) At the time of the visit answer some questions about your child's personality and behavior, and your attitudes towards feeding; allow us to measure your child; keep a record of how much your child eats, and let us observe when you are feeding your child. We will also answer any questions that you may have about the results.
4) Your participation is voluntary (you do not have to be in this study if you do not want to).
5) You can stop participating in this study or to refuse to participate in any procedure or to answer any question at any time you want without having any penalties or repercussions for you or your child.
6) Your identity and your child's identity will remain confidential in any reports of the investigation. The research team and the Institutional Review Board at Rutgers University are the only parties that will be allowed to see the data, except as may be required by law. If a report of this study is published, or the results are presented at a professional conference, only group results will be stated. All study data will be kept for 5 years.
7) There are no foreseeable risks to participation in this study. You may benefit from taking part in this study by having the opportunity to ask questions about your infant's development. As a direct benefit you will receive $30 cash for every 2-day home visit for a total of $210 if you complete the entire study.

Please sign below if you agree to participate in this study. You will be given a copy for your records. If you have any further questions about your participation contact Dr. John Worobey, Department of Nutritional Sciences 26 Nichol Ave., New Brunswick, NJ (worobey@rci.rutgers.edu) Tel: 732-932-6517. If you have any other questions about your rights as a participant in a research study you may contact the Sponsored Programs Administrator at:

Rutgers University Institutional Review Board for the Protection of Human Subjects
Office of Research and Sponsored Programs
3 Rutgers Plaza. New Brunswick, NJ 08901-8559
Tel: 732-932-0150 ext. 2104 Email: humansubjects@orsp.rutgers.edu

"I have read and understood the above description, I have been given the opportunity to ask questions regarding my child's and my participation and I agree to participate in the research":

Signatures:______________________ ______________________________ ___________
Participant Staff Witness Date

Appendix B*: Home Visit Report*

Home-Visit Report-Ring Project

Subject #:_________________ **Date**: _____________

Home visitors: ____

Measurements:

Arm (cm):__________ Weight (kg):_________ Height (cm):__________

Before you leave the house ask:

1. Was the child's behavior in the past 24 hours typical? _____________ (yes/no)
a. If "No", why not? ____
____

b. What do you think might have contributed to such an atypical behavior? (e.g. baby just had shots, baby was sick, etc.)____

2. Will your telephone number and address be the same for the next three months? ____
a. If answer is "No", new address: ________________ new tel. #__________
____
____

3. Thank you very much for your help and remember that we will contact you again in three months/one year (depending on the baby's age). If you have any questions please contact us at (732) 932-2766.

SUMMARY OF EVENTS:
____
____
____
____

EMERGENCY CONTACTS for the Home Visitors:

(732) 932-2766	**and/or**	**John Worobey, Ph.D. (732) 932-6517**
RING Project Office		**Principal Investigator**

Appendix C*: 24-hour Diet Recall*

Subject #: ______________________ Date: ______________________

Directions:

Please complete 2 full days (all meals and snacks).

Indicate Brands if not generic (e.g Tropicana, Dannon, Dorritos, Skippy's PB).
List all ingredients if homemade (e.g.Type of oil used, what vegetables, beef broth or chicken broth).

Dry cereals should be indicated as cups (not in ounces)

Method of Preparation		**Quantities**
* fresh	* raw	* ounces (e.g. 3 oz of meat = size of a deck of cards)
* frozen	* panfried	* # of pieces (e.g. 8 grapes)
* fried	* steamed	* teaspoon
* baked	* grilled	* tablespoon
* canned	* hard-cooked/boiled	* cups (1 cup = 8 oz).

~ Typical day(s): Yes ☐ No ☐

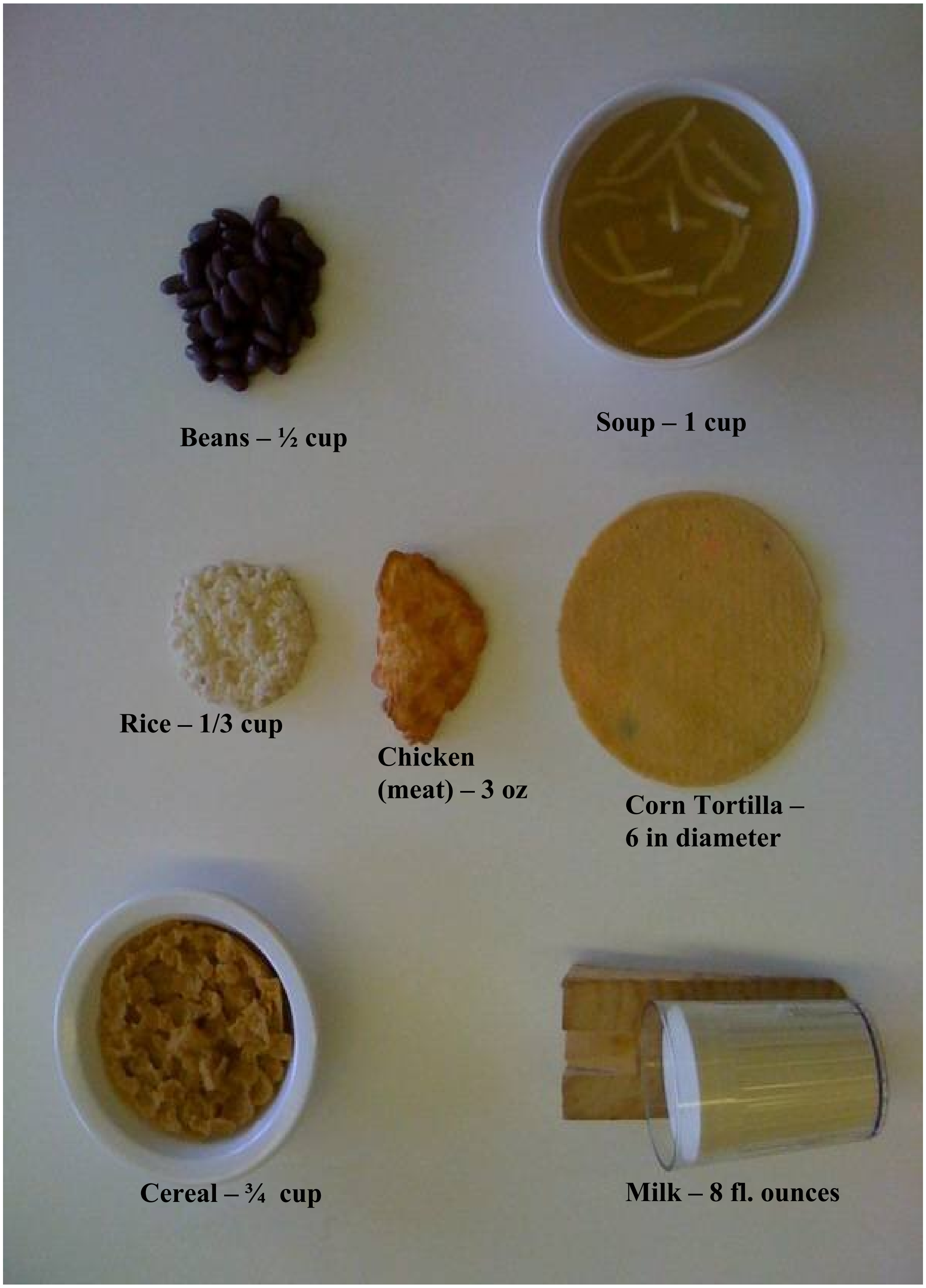
~ 12 mos: Does Infant still receive formula? ________

~ Do you add anything to the formula?________________________________

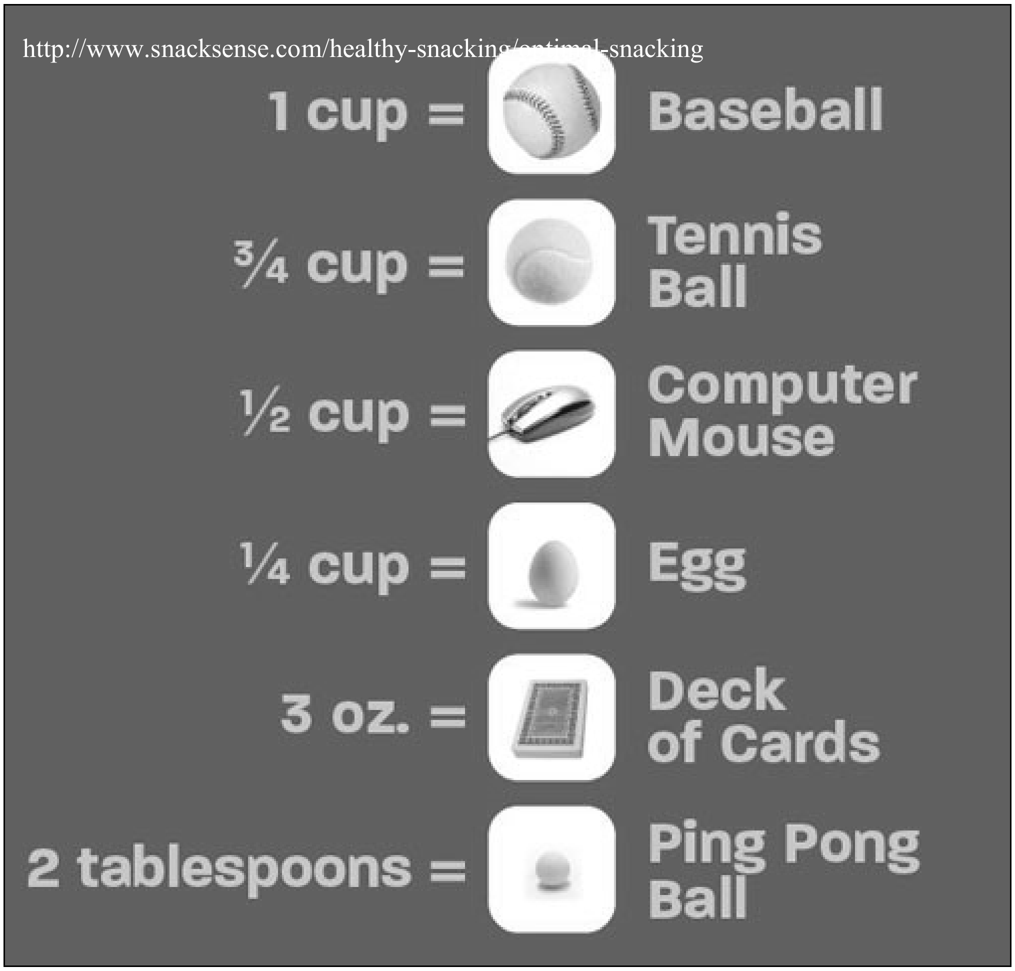
~ Type/brand of Formula? ______________

Time	Type of food/drink	Description	Preparation	Amount
****************** *Example* ******************				
8:00 AM	*Bagel*	*Cinnamon Raisin*	*Toasted*	*half*
Noon	*Chicken*	*Leg and thigh*	*fried*	*1 each*
	100 % Juice	*Tropicana OJ*		*6 oz*
4:00 PM	*Soup*	*Chicken broth*	*Homemade*	*3/4 cup*
		Carrots		*1 Tbsp*
		Potatoes		*1.5 Tbsp*
		Meat only, chicken		*1 oz*
******************************				

Appendix D: *Food Models*



Appendix E*: Visual aides to estimate portion sizes*



Appendix F*: Beverage Intake Log*

BEVERAGE INTAKE LOG

Subject ID#:__________________

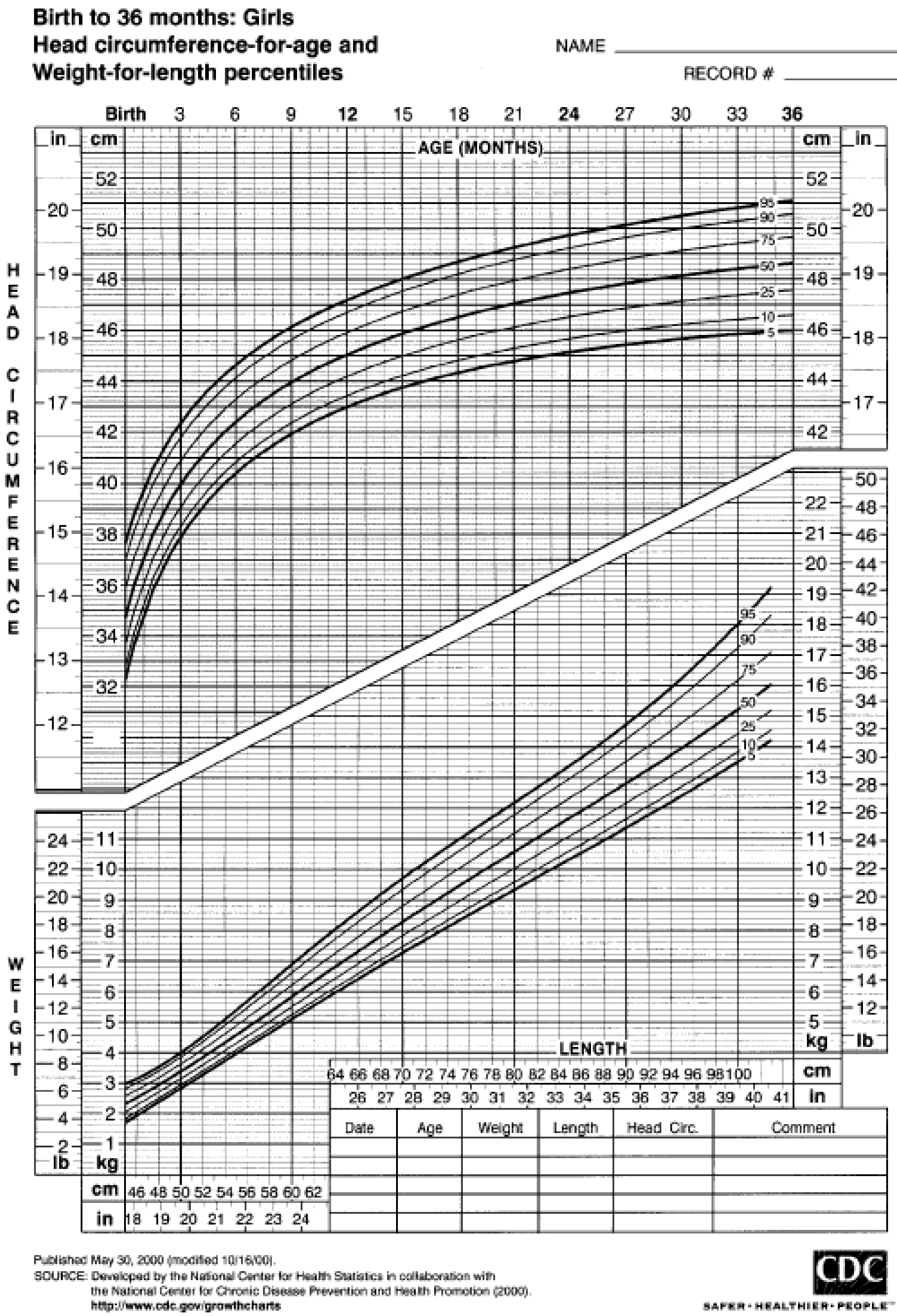
Directions: Use the 24-hour diet recall forms completed during the home visit to fill out this page. DO NOT average if only one day of diet recall was collected.

	Day1	**Day 2**		
	Total fluid ounces	Total fluid ounces	Average Fluid Ounce Intake	Type/Brand/Comments
Juice Drink				
100 % Juice				
Soda				
Coffee				
Tea				
Plain Cow's Milk				
Formula				
Sweetened Formula				
Formula w/added cereal				
Other:__________				

Notes: 1 Tablespoon = ½ fluid ounce

Filled out by (Reaseach Asst.):____________________________________

Appendix G: *Girls Weight for Length Growth Chart, Birth – 36 months*



Appendix H*: Boys Weight for Length Growth Chart, Birth – 36 months*