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The prevalence of overweight among 2-5 year olds has increased from 7.2% in 1988-94 to 13.9% in 2003-2004. Prior research has shown that children of overweight mothers are at increased risk for overweight. The purpose of this study was to determine the dietary intake and predictors of the body mass index (BMI) of 2-year-old children born to overweight/obese mothers.

Participants were recruited from the Active Mothers Postpartum study, which sought to promote postpartum weight loss in women who were overweight or obese prior to pregnancy. Infant feeding information was obtained at 12 months postpartum, and a lactation score was calculated. Weight and height measurements were taken at 2 years postpartum on mothers and their children. Two 24-hour dietary recalls were obtained from the mother for their 2-year-old children. Food group and nutrient intakes were compared with MyPyramid and Dietary Reference Intake recommendations. Selected variables were used to determine the predictors of BMI at 2 years of age.

Dietary information was provided by 243 participants. Twenty three percent and 22% of the children were at risk for overweight or overweight, respectively. Overweight children consumed more vegetables, 100% juice, and desserts. Recommendations for nutrient intakes were met except for dietary fiber. Overweight children consumed more kcal/d, but normal weight children more kcal/kg body weight.

Infant feeding information was provided by 288 participants. Twenty two percent and 25% of the children were at risk for overweight or overweight, respectively.

Breastfeeding, maternal education, gender, and birth weight significantly predicted child's BMI. High intensity/duration of breastfeeding, and higher education predicted a decrease in child BMI. Females had a lower BMI than males, and an increased birth weight predicted an increase in child BMI. Increased consumption of desserts and sweets predicted an increase in child BMI, however it was not significant.

This research indicates that high intensity/duration of breastfeeding may have an effect on a child's BMI at age 2. Furthermore, the higher kcal/kg intake of normal weight children suggests they are more physically active than the at risk for overweight and overweight children.

THE DIETARY INTAKE OF 2-YEAR-OLDS BORN TO OVERWEIGHT OR OBESE MOTHERS AND THE PREDICTORS OF THEIR BODY MASS INDEX

by

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APPROVAL PAGE

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CHAPTER I

INTRODUCTION

The overweight/obesity epidemic is no longer just affecting adults, but is also seen among toddlers, children, and adolescents. According to the 2003-2004 National Health and Nutrition Examination Survey (NHANES), 17% of children and adolescents ages 2-19 years are overweight (1). Among 2-5 year olds, the prevalence of overweight has increased from 7.2% in 1988-94 to 13.9% in 2003-2004 (1). The prevalence of overweight in children and adolescents is expected to nearly double to 30% by the year 2030 (2).

It is well known that obesity has adverse effects on the health of the population. Many disease states are linked to obesity, and obese children can even begin to show signs of morbidity. These disease states can include high blood pressure, cholesterol, triglycerides, and insulin levels. These conditions can then lead to cardiovascular disease, hypertension, and diabetes as these children grow into adulthood. Diagnoses of these diseases result in increased health care costs and a decreased quality of life. The disease states associated with overweight and obesity contribute greatly to increased health care costs. These health care costs are expected to more than double each decade. By the year 2030, 1 dollar for every 6 dollars will be spent on health care due to overweight and obesity (2).

Not only does overweight have medical consequences, but it has psychosocial consequences, which include anxiety, depression, and low self-esteem (3). Overweight children and adolescents have also been shown to complete fewer years of education, have a lower household income as adults, and are less likely to marry (3). Due to the extreme number of consequences related to overweight and obesity, it is necessary for preventative measures to be taken early in life.

A possible contributing factor of childhood overweight could be dietary practices. Consumption of energy dense beverages not only leads to weight gain, but also prevents the child from eating other nutrient dense foods, as the beverages cause them to become full (4, 5). Children of this age are also generally not meeting their fruit and vegetable requirements, which may leave them deficient in several vitamins and minerals (6). Lastly, the convenience of fast food restaurants may lead to childhood overweight/obesity as well. When children eat away from the home and daycare, they tend to consume more French fries, carbonated sodas, and fruit-flavored drinks (7). When considering childhood overweight, dietary intake is a modifiable factor that can be improved. Nutrition education and/or interventions can be conducted with the parents and children to decrease the rate of weight gain, thus preventing them from becoming overweight and experiencing its consequences.

There are many other predisposing factors that can put a child at risk for becoming overweight or obese. Those factors can include race, education, income, gestational weight gain, maternal body mass index (BMI), and birth weight. Different ethnic and racial groups tend to experience higher rates of overweight and obesity than

others (8, 9). Furthermore, less educated parents and/or families with a low income often do not have the knowledge or means to provide healthy food for their families (10-13). Lastly, if the mother has a higher BMI then the child has a higher risk of becoming overweight (10-15).

Breastfeeding is another factor that is thought to have an effect on the BMI of the child. Breastfeeding may have a protective effect against childhood overweight and obesity. Researchers have evaluated the association between breastfeeding and BMI in children and adolescents, and most have found an inverse relationship (8, 11-13, 16-30).

The major predictors of children's BMI need to be pinpointed in order to develop effective interventions that will help decrease the overweight prevalence among children. Socio-demographic characteristics seem to play a role, in addition to the BMI of the mother. The significance of dietary intake and breastfeeding should be evaluated, as those factors can be modified and thus be the focus of future interventions.

Specific Aim

The purpose of this study is to determine the dietary intake of 2-year-olds. The purpose is to also determine the significant predictors of their BMI at 2 years of age.

Research Question

Are 2-year-old children born to overweight/obese mothers meeting the recommended dietary intakes?

Does the dietary intake of normal weight children differ from at risk for overweight or overweight children?

What are the major predictors of the BMI of 2-year-old children born to overweight/obese mothers.

CHAPTER II

REVIEW OF LITERATURE

Introduction

Obesity is a major public health concern that is no longer affecting just adults. The overweight prevalence among children is rising at an alarming rate. Among 2-5 year olds, the prevalence of overweight has increased from 7.2% in 1988-94 to 13.9% in 2003-2004 (1). In order to prevent these increases, the major causes of childhood overweight need to be determined so that interventions can be tailored to alleviate those causes. The current research on the predictors of childhood overweight mostly focuses on older children rather than toddlers. Future research should focus on determining the predictors of BMI at an early age. This will allow interventions to be conducted at an earlier age, and thus hopefully decrease the amount of childhood overweight seen in the United States.

There are several other factors that may contribute to the childhood overweight epidemic. Socio-demographic and parental factors can play a role, especially the weight status of the parents (10-16). Different ethnic and racial groups tend to experience higher incidences of overweight (8, 9). It is also well known that people who are less educated tend to be more overweight and obese than the educated population (10-13). Parental weight status also plays a role in the child's risk of becoming overweight, as overweight parents tend to have overweight children (10-16).

Poor dietary habits among this age group can also heighten the risk of becoming overweight or obese. It has been shown that toddlers and young children do not have adequate fruit and vegetable consumption, and are thus deficient in several nutrients (6). Increased consumption of sweetened beverages and fast food is another major concern (4, 5). Learning about the current diet of toddlers will allow for suggestions to be made as to how to prevent them from becoming overweight.

It is thought that breastfeeding may help prevent overweight later in the child's life. Possible explanations of the protective effects of breastfeeding include behavioral and hormonal aspects. Children who breastfeed are able to regulate their own intake (31), which could possibly set the stage for appropriate regulation through infancy and childhood. Also, protein intakes tend to be lower in children who are breastfed, and it has been thought that higher protein intakes early in life result in overweight later in life (32). Infants who are bottle-fed have also shown higher plasma insulin levels, which could stimulate fat deposition and lead to early development of adipocytes (32).

Socio-demographic/parental factors in relation to childhood overweight

Dubois et al. (2006) determined factors related to childhood overweight at the age of 4.5 years using data from the Quebec Longitudinal Study of Child Development. Weight, height, and monthly weight gain from birth to 5 months of age were measured in 2,103 children. Major factors contributing to being overweight at age 4.5 years included maternal smoking during pregnancy, and rapid weight gain from birth to 5 months. In addition, it was shown that the weight status of the parents also increased the risk of the

child to be overweight or obese at this age, while middle-income and poor families experienced an even greater risk (10).

Hediger et al. (2001) also reported that mother's BMI was the main predictor of child's BMI. The risk of being overweight as a child tripled when their mothers were overweight, and the risk was quadrupled when the mother was obese (14). Bergmann et al. (2003) similarly concluded that mothers with a body mass index of greater than or equal to 27 kg/m^2, smoking during pregnancy, and a low social status were risk factors for an overweight child at age 6. Burke et al. (2005) and Li et al. (2005) reported that higher risks of overweight were also associated with low education, smoking, and maternal obesity (12), especially pre-pregnancy maternal obesity (13).

A cross-sectional study conducted by Gibson et al. (2007) investigated familial factors that influenced childhood overweight at ages 6-13. It was hypothesized that there might be other determinants besides parental weight status. Many measures were taken, including socioeconomic status, family structure, family functioning, parenting scales, and life events scales. Analysis of these tests revealed that having an overweight parent, more specifically the mother, increased the chance that the child would become overweight or obese (15). This was also seen when the mother was a single parent. This illustrates that even after controlling for other familial factors, maternal overweight may be the largest determinant of childhood overweight.

Moschonis et al. (2008) studied 2,374 Greek preschoolers aged 1-5 and sought to identify the factors that put children at an increased risk of becoming overweight. Weight and height of the parents was self-reported during a structured interview. Moschonis et al.

(2008) reported that having an overweight father significantly increased the likelihood of childhood overweight. Another risk factor included mothers who smoked during pregnancy. Most of the research has presented the idea that having an overweight mother is more of a risk factor, whereas in this study the overweight father was a risk factor. The authors suggested that this may be because the mothers underreported their weight, whereas the fathers did not (16).

The majority of the research that has been published indicates that maternal BMI is a major factor in whether the child will become overweight. Other factors such as income, education, smoking, and the father's weight status may also contribute to the risk of a child becoming overweight. These findings highlight the fact that interventions may need to be tailored to overweight, low-income mothers. Emphasizing a healthy lifestyle to the mothers may reduce the risk of overweight among their children.

Dietary Intake of 2-year-olds

Many studies have been conducted regarding the dietary intakes of toddlers. Researchers have been interested in whether or not they are meeting current dietary recommendations as well as their consumption of different food groups and beverages. These studies give readers an insight as to how toddlers are eating and where possible improvements can be made. This information is especially important since the prevalence of childhood overweight and obesity has been increasing.

The main study involving the dietary intake of small children is the Feeding Infants and Toddlers Study (FITS), which was a Gerber Initiative (33). This was a collaborative effort between nutrition researchers, statisticians, and the food industry (33).

The FITS was a cross-sectional survey conducted in 2002, and several reports were published on the data that were collected. FITS consisted of a national random sample of 3,022 infants and toddlers who were divided into six age groups; 4-6 months, 7-8 months, 9-11 months, 12-14 months, 15-18 months, and 19-24 months. The data were gathered through 24-hour dietary recall assessments via the mother, which presents a low respondent burden and its ability to obtain detailed information on brand names and amounts (34). The recalls were obtained using the Minnesota Nutrition Data System for Research (NDSR) software, developed by the Nutrition Coordinating Center (NCC), University of Minnesota, Minneapolis, MN. The participants were also given a food measurement booklet which included pictures of appropriate utensils often used by infants and toddlers to assist them in estimating portion sizes (34).

One of the many reports published from the FITS included information on the major nutrient and energy sources for the children (35). The top sources of energy among the ages of 12-24 months old included milk, 100% juice, and sweetened beverages. The consumption of these sweetened beverages increased with age, from 3% at 12-14 months to 6% at 19-24 months. This is important to note, as the consumption of sweetened beverages may play a large role in whether or not a child later becomes overweight or obese. The major sources for each macronutrient were included in the report. The top sources of protein for toddlers were milk, chicken, turkey, cheese, and beef. The top sources of fat were milk, cheese, butters/oils/margarines, and hot dogs, cold cuts, and bacon. Lastly, toddlers receive the majority of their carbohydrates from milk, 100% juice, sweetened beverages, and breads (35). Researchers also discovered

that fortified foods and supplements contribute greatly to the intakes of certain vitamins and minerals for these toddlers (35).

The FITS also examined average portion sizes consumed per eating occasion by infants and toddlers (36). These data were also taken from the 24-hour dietary recalls. Foods that were reported in the NDS were put into major and minor food groups, excluding foods that were not consumed by at least 5% of the population being studied. The number of times a child ate during the day were called eating occasions. The 19-24 month age group typically consumed 6 fluid ounces of milk per eating occasion. The average portion size of milk added to cereal for was 3-4 fluid ounces. Examples of average serving sizes from the breads and grains group were as follows; 1 slice of bread, 2/3 cup hot cereal, ½ cup pasta, 1/3 cup rice, and ½ - 2/3 cup of ready to eat cereal. Fruit and vegetable portion sizes were normally ½ cup.

The two most common vegetables eaten by toddlers were French fries and green beans, and the serving sizes of the French fries were 2 to 3 times larger than serving sizes of any other vegetables (36). Fruit juice portion sizing was about 5 fluid ounces for ages 15-24 months, compared to 4 fluid ounces at ages 12-14 months, suggesting that with increasing age, juice consumption increases. Meat, fish, and poultry tended to be eaten in 1 ounce portion sizes. Other average portion sizing for commonly eaten foods among 19-24 month-olds included 3 chicken nuggets, 2/3 cup macaroni and cheese, ¾ cup pasta with tomato sauce, 1 tablespoon peanut butter, 4 ounces of yogurt, and 1 ounce of cheese (36). This report on portion sizes could not only serve as a guideline for parents and caregivers, but gives an idea as to how portion sizes change between infants and toddlers.

The FITS also compared toddler supplement users to non-users to determine whether or not these supplements contribute to their nutrient adequacy. This analysis has enabled the researchers to see what nutrient inadequacies occur in toddlers who do not use supplements. Approximately 65% of supplement nonusers had inadequate intakes of vitamin E. All toddlers, both users and nonusers of supplements, had excessive sodium intakes. Excessive intakes for vitamin A, folate, and zinc were also noted for supplement users (37).

Another report published on the FITS described the food patterns of lunches and snacks eaten by toddlers (7). A sub-sample was used for this analysis, which consisted of 632 toddlers from the ages of 15 months to 24 months. Locations were separated into three categories which included home, day care, and away. An away location included any other location besides home and day care. It was shown that those lunches eaten at day care contained higher amounts of needed nutrients such as calcium, vitamin D, and potassium, than those eaten at home or any other location (7). Trans fat intake was lower in meals eaten at home than meals eaten away. Mean energy intakes for lunch ranged from 281 kilocalories to 332 kilocalories at home and day care, respectively. Morning snacks ranged from 124-156 kilocalories, and the afternoon snacks ranged from 139-170 kilocalories. Between the locations, there was no significant difference between macronutrient and fiber intakes. French fries, carbonated soda, and fruit-flavored drinks were consumed very frequently at locations other than day care and home (7). Through this report it is apparent that eating lunch away from day care or home may lead to poor choices such as carbonated beverages, sweetened beverages, and French fries.

Knowing that sweetened drinks can contribute to the childhood obesity epidemic, some researchers chose to look at those beverages alone. A study conducted in Canada revealed that regular consumption of sugar-sweetened beverages can put many children at risk for being overweight (5). The data that were used were taken from the Longitudinal Study of Child Development in Quebec, which ran from 1998-2002. A sample of children born in Quebec in 1998 was used, along with a sample of children at 4-5 years of age in 2002. Heights, weights, and 24-hour dietary recalls were used in the analysis, along with sugary beverage consumption between meals at the ages of 2.5, 3.5, and 4.5. The analysis revealed that the children who did not consume sugary beverages were less likely to be overweight at age 4.5 (5). It was shown that those children who do consume sugary beverages and those who are part of low income families were three times more likely to be overweight at age 4.5 (5). This study suggests that children should not be consuming these sugary beverages between meals when they are young, in order to prevent the possibility that they may become overweight or obese.

Dennison et al. (1997) examined the juice consumption of young children. This study was conducted on 2- and 5-year-old children in 1997 and revealed that the consumption of equal to or more than 12 fluid ounces per day of fruit juice resulted in short stature and obesity among this population (4). Therefore, it was advised that parents keep fruit juice consumption to a minimum, and definitely less than 12 fluid ounces per day. It is very apparent that fruit juice is a major component of a toddler's diet, which may ultimately contribute to childhood overweight and obesity due to the

high calorie content that some of these juices may contain. With excessive juice consumption, the child may not be hungry for other nutritiously dense foods.

Similarly, O'Connor et al. (2006) reported that the amounts of different types beverages consumed by children aged 2-5 years was associated with an increased overall energy intake (38). However, there was no association seen with BMI. In addition, these preschool children were not meeting the recommended number of milk servings per day, and only 8.6% of the children were drinking lowfat or skim milk. The average amount of 100% juice consumed in this sample was ~5 fl oz, which is appropriate.

In 1998, Dennison et al. conducted another study which reported on the fruit and vegetable intake of young children. These preschool children consumed approximately 80% of the recommended fruit serving per day, 50% of which was due to fruit juice consumption (6). The children were only consuming 25% of the recommended vegetable servings per day (6). Because of the low intake of fruits and vegetables, these children were not getting the adequate intakes for certain vitamins, such as vitamin A, C, and dietary fiber. Dennison et al. have illustrated that children generally do not meet their fruit and vegetable needs.

Overall, the dietary intake of toddlers needs to be monitored in order to prevent childhood obesity and overweight. Parents and caregivers play a large role in providing a variety of nutritious foods to the children, and limiting fruit juices, sodas, and fast foods eaten away from the home should become a priority. A variety of nutritious foods should allow them to maintain a healthy, normal weight. With information on the average

intakes and portion sizes of toddlers, researchers will be able to see to what extent their dietary intake is related to the childhood overweight and obesity epidemic.

Breastfeeding as a predictor of childhood overweight

An important factor that may predict childhood overweight is breastfeeding. Several studies have been conducted on this topic, and the research approaches vary. Different age groups and breastfeeding groups have been used. Researchers may control for different variables as well. To date the research is inconclusive, as many believe that breastfeeding does have a protective effect against overweight (8, 11-13, 16-30), while others believe it to be due to other lifestyle and parental factors (14, 39). Studies on the relationship of breastfeeding and childhood overweight are summarized in Table 1. Protective effects may also differ between different racial/ethnic groups (8, 29, 30), possibly because breastfeeding interacts with other risk factors that differ across racial/ethnic groups (29). Explanations as to why breastfeeding may have a protective effect include self-regulation of breast milk intake, metabolic programming, protein intake, and rate of weight gain in early life (31).

There are several studies that have seen associations between breastfeeding and overweight. Weyermann et al. (2006) looked at 1,066 German children in a prospective birth cohort. He examined the effect of breastfeeding with the use of four different breastfeeding groups, as well as the duration of exclusive breastfeeding. The four groups were as follows: < 3 months, 3 to < 6 months, 6 to < 9 months, and ≥ 9 months. This study is set apart from others in that it did not use children who were never breastfed as a reference group. At the 2-year follow-up, 8.4% were overweight and 2.4% were severely

overweight. A number of confounding factors were also considered, including nationality, mother's education, mother's BMI, smoking status during pregnancy, and birth weight of the child. The results indicated that prolonged breastfeeding helps in preventing overweight in children. The odds of being overweight decreased significantly when looking at both duration of breastfeeding and duration of exclusive breastfeeding. The risk of overweight decreased in children who were exclusively breastfed for at least 6 months when compared to those who were breastfed for less than 3 months (17).

Burke et al. (2005) conducted a birth cohort study on 2,087 children in Australia, which assessed adiposity in relation to breastfeeding at 1, 3, 6, and 8 years. Analysis at the first year used weight-for-length, while the remaining used body mass index (BMI). Those infants who were breastfed for 12 months at the one year follow-up were the leanest group. For the remaining years, a breastfeeding duration of ≤ 4 months posed the greatest risk of being overweight (12). Li et al. (2005) also discovered that breastfeeding for < 4 months was also shown to have a higher risk of childhood overweight (n=2,636). The lack of breastfeeding, combined with maternal obesity, is thought to be an additive interaction, suggesting that overweight mothers should be targeted for additional support in breastfeeding (13). Buyken et al. (2008) also reported this interaction, but only in males (n=434).

Other researchers have found that breastfeeding for < 3 months posed a risk for childhood overweight (11, 19). Bergmann et al. (2003) conducted a longitudinal birth cohort study of 1,314 6-year-olds in Germany. Two breastfeeding groups were used; those children who were bottle fed or breastfed for less than 3 months and those who had

been breastfed for longer than 3 months. After considering multiple other factors that could contribute to childhood overweight, Bergmann et al. (2003) found that bottle feeding was a risk factor for overweight at the age of six.

Tulldahl et al. (1999) surveyed 781 adolescents up to the age of 18, and took anthropometric measurements including skinfolds, along with information on infant feeding patterns. Breastfeeding groups included exclusively breastfed for more than 2 months, or less than or equal to 2 months. Girls who were breastfed for 3 months or less had more adipose tissue. A subsample of the participants had body composition measured by dual energy X-ray absorptiometry. The girls and boys who were breastfed for 3 months or longer tended to be leaner and had lower skinfold values. The results suggested that breastfeeding does have a protective effect against overweight in adolescence, however it is important to note that no adjustments for confounding factors were made in the analysis. The possible mechanism suggested here was that formula fed infants may be at risk for overfeeding which might lead to overweight in adolescence (19).

Victora et al. (2003) studied 2,250 Brazilian men at the age of 18 years in a birth cohort study. The main purpose was to investigate whether or not there was an association between body composition indices and breastfeeding. Follow-ups had been conducted when the boys were 1, 2, and 4 years old, which was when breastfeeding information was collected. Although breastfeeding was not associated with adiposity or other body composition indices, the risk of obesity was cut in half in subjects who were

breastfed for at least 3-5 months. A trend between the reduced risk of obesity and increased predominant breastfeeding durations was also seen (20).

Others have found that breastfeeding for at least six months is protective against childhood overweight (16, 21, 22). Shields et al. (2006) studied the association in 3,698 14-year-olds in Australia. Breastfeeding duration information was obtained, as well as the BMI of the children and other confounding variables. Before adjusting for confounders, breastfeeding for longer than 6 months was protective of obesity only. However, after adjustment, the effect seen was no longer statistically significant. An inverse association trend was still seen with breastfeeding and overweight at this age. Although Shields et al. (2006) found that breastfeeding was protective against obesity only, Moschonis et al. (2008) did find an association between 6 months of breastfeeding and overweight. The results showed that Greek children (n=2,374) who were exclusively breastfed for the first 6 months of life were less likely to be overweight than exclusively formula fed children. At 12 months of age, breastfeeding still remained inversely associated with overweight status (16). Lastly, Mayer-Davis et al. (2006) assessed the relationship between infant feeding for the first 6 months of life and overweight in 15,253 children. Those infants who were fed breast milk only compared to formula fed only had a reduced risk of being overweight (21).

The Commonwealth of the Northern Mariana Islands assessed the prevalence of breastfeeding and childhood overweight as well as the relationship between the two (23). A sample of 420 children, aged 6 months to 10 years were included in the analysis. This population had been experiencing an increase in overweight and obesity along with

obesity related diseases when compared to the United States mainland. Nineteen percent of the children were considered overweight as classified by the Center for Disease Control BMI-for-age criteria. There were six breastfeeding groups used in study; $0 \leq 2$ months, $>2 \leq 4$ months, $> 4 \leq 6$ months, $> 6 \leq 9$ months, $> 9 \leq 12$ months, and > than 12 months. Adjustments were made for age, sex, birth weight, and mother's education. Results indicated that any amount of breastfeeding was negatively associated with BMI (23). A possible explanation as to why there was no dose-dependent effect seen here is that the sample size was small, and very few participants exclusively breastfed for more than 6 months. When subdividing the participants into breastfeeding groups with a small sample size, few participants are left in each group.

Armstrong et al. (2002) studied 32,200 3-4-year-olds in Scotland. The researchers differentiated the feeding groups between those who were exclusively breastfed and those that were exclusively formula fed at 6-8 weeks. Twenty-five percent received breast milk only, and 68% received formula only. After adjusting for several confounding factors, it was concluded that overweight risk was reduced in those children who were breastfed (24).

Although one review paper deemed the protective effect of breastfeeding to be small but consistent (32), significant dose-dependent relationships between breastfeeding duration and a lower risk of overweight among children has also been shown in several studies (25-28). In a meta-analysis, Harder et al. (2005) saw a strong dose-dependent association. With every month of breastfeeding, there was a 4% reduction in overweight risk (40).

Gillman et al. (2001) studied a cohort of 9- to 14-year-olds. For the first 6 months of life, the researchers determined whether the child was predominantly breastfed or predominantly formula fed. From 0-6 months, 62% of these participants were exclusively breastfed, while 31% received mostly infant formula. Infants who were fed breast milk more than formula or who were breast fed for a longer duration had a lower risk of being overweight in childhood and adolescence. The duration of breastfeeding was also assessed using the following groups: 0 months, < 1 month, 1-3 months, 4-6 months, 7-9 months, and > 9 months. This study also showed a significant dose response relationship. Those who were breastfed for at least 7 months were less likely to be overweight than those who were breastfed for no more than 3 months. This study may be the best to date, as it had a large sample size (n=15,341) and adjusted for several potential confounding factors (25).

Two more studies that discovered a dose-dependent relationship looked at breastfeeding groups that included ever breastfed versus exclusively formula fed, in addition to the duration of full breastfeeding in 5-6 (n=9,357) and 6-14 (n=33,768) year-old children (26, 27). When looking at the duration of exclusive breastfeeding, the odds ratio for a higher BMI decreased with increased durations of breastfeeding relative to those who had never been breastfed (26). The prevalence of overweight among 5-6-year-olds was 3.8% for less than 2 months of breastfeeding compared to 0.8% for more than 12 months of breastfeeding (26). Toschke et al. (2002) observed a decrease in the percentage of overweight children with an increased duration of breastfeeding. The prevalence of overweight in children who were never breastfed was 12.4% compared to

9.0% for those who were breastfed for longer than 6 months (27). These results indicated that prolonged breastfeeding may decrease overweight in childhood in a dose-dependent manner (26, 27). After controlling for maternal BMI, a significant dose response relationship was still seen. However, this relationship was only seen when socioeconomic status was homogenous. A limitation here was that there was no information on the exclusivity of breastfeeding. (27)

Liese et al. (2001) examined 2,108 9- to 10-year-olds in a cross-sectional study that took place in Germany. Dresden and Munich were the two cities chosen to study. The breastfeeding groups included ever breastfed, exclusively formula fed, and durations of breastfeeding and exclusive breastfeeding. It was concluded that early nutrition has preventive potential in the development of overweight in children. The effect seen here was significant and dose-dependent. There was a higher prevalence of overweight among the children who were never breastfed (Dresden 16.4%, Munich 24.3%) compared to those who were (Dresden 9.9%, Munich 15.2%). Even though the overweight status of the children in the two cities differed, there was still evidence that those children who were breastfed were less likely to be overweight (28).

There is substantial research suggesting a protective effect of breastfeeding; however, other researchers have suggested otherwise. Hediger et al. (2001) studied 2,685 3-5 year olds, and analyzed them as ever breastfed versus exclusively formula fed, but also took into consideration the duration of full breastfeeding. This same approach was taken in other studies; however, in this study there was no reduced risk of being overweight and no clear dose-dependent association, and there was no threshold effect

(14). Because this study found other factors that were associated with childhood overweight, such as maternal overweight, it was suggested that the association between breastfeeding and childhood overweight was confounded by those factors (14).

Owen et al. (2005) reported in a review, which included both published and unpublished studies, that mean body mass index is lower among those children who are breastfed. However, the authors also stated that confounding factors play a role in the association seen between mean BMI and breastfeeding. Overall, Owen et al. promotes breastfeeding for many other reasons, but suggests that it will not reduce BMI (39). The role of breastfeeding in preventing childhood overweight is probably small compared to other factors such as maternal BMI, dietary habits, and physical activity levels (31).

Researchers have also suggested that the protective effect of breastfeeding differs among racial/ethnic groups (8, 29, 30). Three –year-olds from twenty large cities in fifteen different states were surveyed (n=2,146). These children were either White (n= 419), Black (n=1182), or Hispanic (n=545). The researchers adjusted for maternal BMI, smoking, age, relationship status, education, child's birthweight, and the household income-to-poverty ratio. The only significant association seen was with the Hispanic children. The prevalence of overweight was lower in Hispanic children who were ever breastfed compared to those that were never breastfed. The authors concluded that breastfeeding as a preventive method against overweight may interact with other factors that differ across race and ethnicity (29).

This association was also studied 3,692 low-income families and their 4-year-old children in Kansas. Procter and Holcomb (2007) separated breastfeeding durations into

weeks which included: 0, 1-8, and ≥ 9 weeks. Before any adjustments were made, breastfeeding for 9 weeks or more was protective in non-Hispanics. In the total sample, gender, ethnicity, birthweight, mother's BMI, and formula use were all associated with overweight. When analyzing the White children only, birthweight, mother's BMI, and formula use were associated with overweight. However, after controlling for other confounding factors, the association was no longer significant. The researchers noted that women who breastfeed for longer durations may be different than women who do not in ways that are not measured in the analysis (8).

Similarly, 177,304 low-income, 4-year-old children all over the United States were examined to determine whether increased duration of breastfeeding was associated with a lower risk of overweight (30). The analysis here, however, stratified the results by racial/ethnic groups. Six breastfeeding categories were used, including never, <1 month, 1-2 months, 3-5 months, 6-11 months, and ≥ 12 months. In this low-income population, breastfeeding was protective among non-Hispanic Whites only (30). The lifestyles of the other racial/ethnic groups included in this study are noted to be quite different, and breastfeeding may not be sufficient to overcome those lifestyle factors (30).

Overall, several research studies have shown that breastfeeding can be protective of childhood overweight, especially if done for longer durations. It appears that the minimal dose to see an effect is 3 months of exclusive breastfeeding. Some believe the protective effect of breastfeeding is very small, and that other lifestyle factors play a larger role in predicting the child's BMI. Whether or not breastfeeding will be protective or not may also depend on the race or ethnic background of the child.

Conclusion

Previous research has shown that there are many factors that can contribute to childhood overweight and obesity. Dietary intake, predisposing parental factors, and duration of breastfeeding are three of those possible factors. Inadequate fruit and vegetable consumption (6), along with increased intake of sweetened beverages (4,5) may be contributing to the childhood overweight epidemic. Maternal and paternal weight status is believed to have a bearing on whether or not the child will become overweight, along with the socioeconomic status of the family. In some cases, this may be alleviated by breastfeeding. Breastfeeding for longer durations may result in a decreased risk of childhood overweight and obesity (8, 11-13, 16-30), and some researchers have found stronger associations than others. However, the decrease in risk could depend on race or ethnic background of the individual (8, 29, 30). Also, mothers who choose to breastfeed may be in some way different from mothers who do not, which may not be measured by the researchers.

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TABLES

Table 2.1 Studies on the Relationship Between Breastfeeding and Childhood Overweight

Author, Year	Site	Ages	Sample Size	Feeding groups	Results
Armstrong et al. 2002	Scotland	3-4 years	32, 200	EBF vs. EFF @ 6-8 wks	BF associated with reduction in childhood overweight risk
Hediger et al. 2001	US	3-5 years	2,685	Ever BF vs. EFF, duration full BF (0, ≤ 2 mo, 3-5 mo, 6-8 mo, ≥ 9 mo)	Weak association between BF and risk of overweight
von Kries et al. 1999	Germany	5-6 years	9,357	Ever BF vs. EFF, duration EBF (≤ 2 mo, 3-5 mo, 6-12 mo, > 12 mo)	Prolonged BF may decrease overweight in childhood
Toschke et al. 2002	Czech Republic	6-14 years	33,768	Ever BF vs. EFF, duration BF (≤ 1 mo, 1-3 mo, 3-6 mo, > 6 mo)	Reduced prevalence of overweight was assoc. with BF when socioeconomic status is homogenous
Liese et al. 2001	Germany	9-10 years	2,108	Ever BF vs. EFF, duration BF (< 6 mo, 6-12 mo, > 1 yr) or EBF (< 2 mo, 2-4 mo, 5-6 mo, > 6 mo)	Early nutrition has possible preventive potential in development of overweight children
Gillman et al. 2001	US	9-14 years	15,341	predominantly BF vs predominantly FF from 0-6 mo. , duration of BF (0, < 1 mo, 1-3 mo, 4-	Infants who were fed breast milk more than formula or who were BF for longer had a lower risk of being overweight in childhood and adolescence

				6 mo, 7-9 mo, > 9 mo)	
Tulldahl et al. 1999	Sweden	17-18 years	781	EBF > 2 mo. vs. EBF ≤ 2 mo.	Formula fed infants may be at risk for overfeeding which might lead to overweight in adolescence
Bergmann et al. 2003	Germany	6 years	1,314	bottle fed/BF less than 3 mo. Vs. BF > 3 mo.	Mother BMI ≥ 27, bottle feeding, smoking, and low social status are risk factors for overweight at 6 yrs.
Shields et al. 2006	Australia	14 years	3,698	still BF, 4-6 mo, 7 weeks-3 mo, 3-6 weeks, < 3 weeks, none	BF > 6 mo. has modest protective effect against obesity in adolescence
Author, Year	**Site**	**Ages**	**Sample Size**	**Feeding groups**	**Results**
Weyermann et al. 2006	Germany	24 mo.	1,066	< 3 mo, 3- < 6, 6-< 9, ≥ 9 mo, duration of EBF (never, < 3 mo, 3-< 6 mo, ≥ 6 mo)	Prolonged BF for prevention of overweight in children
Burke et al. 2005	Australia	8 years	2,087	never, ≤ 4 mo, 5-≤ 8 mo, 9-≤12 mo, > 12 mo	BF for less than 4 months assoc. with greatest risk of overweight
Procter et al. 2007	US	4 years	3,692	Weeks: 0, <4, 4-11, 12-23, 24-51, ≥52	Cultural factors may override the protective effect of BF
Grummer-Strawn	US	4 years	177,304	never, < 1 month,	Longer durations of BF is

et al. 2004				1-2 mo, 3-5 mo, 6-11 mo, ≥ 12 mo	assoc. with reduced risk among non-Hispanic whites
Novotny et al. 2007	CNMI	6 mo-10 years	420	0-≤2 mo, 2-≤4, 4-≤6, > 6, 6-≤9, 9-≤12, >12 mo	Children who BF had lower BMI than those who had not
Victora et al. 2003	Brazil	18 years	2,250	duration of total and predominant BF (< 1 mo, 1-2 mo, 3-5 mo, 6-8 mo, 9-11 mo, ≥ 12 mo)	No association between BF and anthropometric and body composition indices but decreased risk for those BF for 3-5 mo
Buyken et al. 2008	Germany	7 years	434	> 2-16 weeks, ≥ 17 weeks	BF offsets adiposity among boys with overweight mothers
Moschonis et al. 2008	Greece	1-5 years	2,374	EBF vs. mixed vs. exclusively FF	BF children less likely to be overweight
Mayer-Davis et al. 2006	US	9-14 years	15,253	never, < 1 month, 1-3, 4-6, 7-9, > 9 months	BF inversely assoc. with childhood overweight
Li et al. 2005	US	2-14 years	2,636	never, 1-3 months, ≥ 4 months	Lack of BF associated with greater risk of childhood overweight
Burdette et al. 2007	US	3 years	2,146	never, < 4 mo, ≥ 4 mo	Relationship differed by ethnicity

BF = breastfed
FF = formula fed
EBF = exclusively breastfed
EFF = exclusively formula fed

CHAPTER III

THE DIETARY INTAKE OF 2-YEAR-OLDS BORN TO OVERWEIGHT/OBESE WOMEN

Introduction

The prevalence of overweight among toddlers and children has increased over the years and will continue to increase (1). The increased prevalence of overweight among children will result in several medical and psychosocial consequences (1). Additionally, overweight results in increased health care costs (1). Toddlers are of special interest because there is currently limited research on this age group, and eating habits are established at this early age.

Certain dietary practices among pre-school aged children could possibly contribute to their risk of becoming overweight. Consumption of energy dense beverages not only leads to weight gain, but also prevents the child from eating other nutrient dense foods, as the beverages cause them to become full (3). Children aged 2-5 are also generally not meeting their fruit and vegetable requirements, which may leave them deficient in several vitamins and minerals (4). The decreased consumption of fruits and vegetables is also correlated with high intakes of fats (4). Lastly, the convenience of fast food restaurants may lead to childhood overweight as well. When children eat away from the home and daycare, they tend to consume more French fries, carbonated sodas, and fruit-flavored drinks (5).

Other factors are thought to contribute to the childhood obesity epidemic. Lower education or income (6-9), race (10, 11), high gestational weight gain (6, 12, 13), an increased birth weight (6, 11), and an increased maternal BMI can increase the child's risk of becoming overweight (6-9, 12, 14). When the mother is considered to be overweight, the child's risk of overweight tripled. That risk quadrupled when the mother was obese (12).

To date, there is limited research on the dietary intake of 2-year-olds. In addition, there is limited research on children born to overweight/obese mothers. These children are at a higher risk for becoming overweight. The purpose of this observational study was to determine the dietary intake of 2-year-olds who were born to overweight/obese mothers. These findings can be used to help guide the development of interventions aimed at decreasing childhood overweight in high risk children.

Methods

Participants

Participants were recruited from the Active Mothers Postpartum (AMP) study (15). The AMP study was a two-arm randomized trial of 450 women who were overweight or obese prior to pregnancy. The purpose of the AMP study was to promote weight loss in postpartum women who were overweight or obese prior to pregnancy. At 2 months postpartum, the women were randomized to a minimal care group or the intervention group. The minimal care group received monthly "healthy tips" newsletters, while the intervention group had the opportunity to participate in physical activity

sessions, nutrition education classes, and counseling calls for nine months. At the 2 year postpartum AMP visit, participants were asked to participate in the AMP too for Twos! study. The purpose of the AMP too for Twos! study was to understand how family and child factors relate to postpartum weight retention, as well as to evaluate how the child's BMI is affected by these factors. At the 2 year postpartum AMP visit, informed consent was obtained (Appendix C). This protocol was approved by the Institutional Review Boards of Duke University and the University of North Carolina at Greensboro.

Measurements/Surveys

Baseline measurements for the AMP study were conducted at approximately 2 months postpartum. Information on race, education, income, gestational weight gain, and marital status were obtained by a telephone survey. At 24 months postpartum heights and weights of the mother and their 2-year-old child were measured using a Seca portable stadiometer (Columbia, MD) and a Tanita BWB-800 scale (Arlington Heights, IL). Participants wore light clothing and took their shoes off for these measurements.

Within two months of the anthropometric measurements, two dietary recalls of the child were collected from the mother using the University of Minnesota's Nutritional Data System for Research (NDSR) software version 2007, developed by the Nutrition Coordinating Center (NCC), University of Minnesota, Minneapolis, MN. Mothers were asked what their child ate during the previous day. If children attended daycare, mothers gave the daycare provider a form to record the dietary intake (Appendix A). Daycare providers were instructed to write down what and how much was consumed by the children. Mothers used this list to complete the 24-hour recall.

The child growth standards of the World Health Organization (WHO) were used to determine BMI z-scores of the children (16). These were released in April 2006 and are based on the growth of 8,440 children in the United States, Brazil, Ghana, India, Norway, and Oman. These children were selected based on an optimal environment for proper growth. They were exclusively breastfed, had standard pediatric healthcare such as vaccinations, and their mothers did not smoke. The WHO growth standards were used rather than the CDC growth charts because the WHO growth standards depict how children should grow, given an optimal environment.

The BMI z-scores were used to separate the participants into three weight categories: normal weight, at risk for overweight, and overweight. For this analysis, children below the 85^{th} percentile (z-score = -1.64 to 1.03) were considered to be at a normal weight. Children between the 85^{th} and 94.9^{th} percentiles (z-score = 1.04 to 1.63) were considered to be at risk for overweight. Children at or above the 95^{th} percentile (z-score = $\geq$ 1.64) were considered to be overweight.

Statistical Analysis

Analysis was completed using JMP statistical software version 7.0 (SAS, Cary, NC). Chi-square and ANOVA were used to compare demographic characteristics between the normal weight, at risk for overweight, and overweight children. For nutrient analysis, the two dietary intakes were averaged. Averages and standard deviations are reported. Food group and serving sizes were defined by the NDSR software. They were then combined into the following food groups: vegetables, grains, protein, dairy, fats, beverages, desserts and sweets, and fast food. Vegetables, grains, protein, dairy, and

beverages had additional sub-groups. Examples of serving size amounts for desserts include 30g cookie, 40g brownie and candy, 125g pies and pastries, and 2TB of chocolate sauces. Fast food is defined as the number of times, including meals or snacks, that the child ate fast food within the two dietary recall days. Food group servings consumed were compared to the MyPyramid recommendations. To compare the intake of food groups of normal weight children with the at risk for overweight and overweight children, ANOVA was used for each of the specified outcome measures. Tukeys-Kramer HSD was used to compare means for the food groups and nutrients that were found to be significantly different between groups. Level of significance was $P \leq 0.05$.

Results

Demographic Information

Three hundred and four mother and child pairs joined AMP Too for Twos! Of those participants, 243 provided dietary information. Mothers that provided diet information had a higher education ($p=0.03$) and had children with a lower BMI ($p=0.02$) than those who did not participate in the diet recalls. Of these 243 participants, 48 only had one day of dietary intake, and were included in the analyses. The participants that provided only one day of dietary intake were different from those that provided two days of dietary intake in that they had a lower level of education and were Black or other race. Of the 243 participants, race was evenly distributed between White and African-American. A small number were Asian (1.6%) and "other" (3.7%). The majority of the mothers were older than 30 years of age, were married, had a college education, and had an income of $60,001 or more. The mean body mass index (BMI) at 2 years postpartum

was 32.8 ± 7.5 kg/m^2. The mean birth weight of the children was 3.4 ± 0.6 kg, and mean BMI at 2 years of age was 17.1 ± 1.4 kg/m^2.

The participant characteristics according to weight category of the toddlers are presented in Table 2. Of the 243 participants, 23% were at risk for overweight and 22% were overweight. Two children were underweight (BMI z-score < -1.64) and were included in the normal weight group for analysis. According to the CDC growth charts, 14.8% of children in this population were considered to be overweight, and 9.1% of children were considered to be obese. Therefore, approximately 24% of children were overweight or obese. Children who were considered to be overweight (BMI > 94.9th percentile) had higher birth weights (p=0.08) than at risk for overweight and normal weight children. There were no differences between groups in race, maternal age, marital status, education, income, and the gender of the child.

Dietary Analysis

Food Groups

The number of servings consumed by the 2-year-olds from each food group is presented in Table 3. Children met the recommended number of servings as determined by the USDA MyPyramid (17) for all food groups except for fat, fruits, and vegetables. Fat intake was low at 1 teaspoon compared to recommended amount of 3-4 teaspoons per day. Fruit and vegetable intakes were low at approximately 1 serving (1/2 cup) compared to the recommended amount of 1-1 ½ cups per day. Although MyPyramid includes 100% juice in the fruit group, it was kept as a separate category for this analysis to see if 100% juices alone contributed to overweight. If 100% juice were included in the fruit

group for this analysis, then the average number of fruit serving recommendations would be met by all three groups. Significant differences between weight groups was seen with desserts ($p=0.03$). Differences were also seen with vegetables ($p=0.07$) and 100% juice ($p=0.06$), but they were not significant. Overweight children consumed more vegetables, 100% juice, and desserts and sweets than normal weight and at risk for overweight children. Common desserts consumed were chocolate syrup when added to milk, and pre-packaged cookies. While not statistically significant, the at risk for overweight children often consumed less servings of most food groups than both the normal weight and overweight children.

Nutrients

The amount of nutrients consumed by the 2-year-old children is presented in Table 4. Overall, the average intake met or exceeded the recommendations for all nutrients except dietary fiber. Overweight children consumed more kcal/day; however, normal weight children consumed more kcal/kg body weight. Differences between groups were seen with energy, kcal/kg body weight, carbohydrates, fiber, folate, thiamin, vitamin C, vitamin K, and iron ($p \leq 0.05$).

Discussion

This sample had an even distribution of Whites and African Americans. Previous research studies have been conducted on predominantly white populations (4, 5). There is a limited amount of research only on 2-year-olds, especially children born to overweight/obese mothers. Therefore, this is a unique cohort to investigate dietary intake.

Almost half (45%) of the children were either at risk for overweight or overweight, with 22% being overweight. NHANES 2003-2004 reported an overweight prevalence among children aged 2-5 to be 13.9% (18). When using the CDC growth charts, 14.8% of children were overweight and 9.1% were obese, totaling approximately 24%. The CDC growth charts underestimate the total percent at risk for overweight, overweight, and obese children (24% vs. 45%).

The high percentage of overweight seen here may be due to increased consumption of 100% juice and desserts, as these food items were consumed in greater amounts by the overweight children. Average consumption of sweetened beverages , fast food , and soft drink consumption was minimal. Since the consumption of these foods was not different between groups, then it is unlikely that they contributed to the overweight status of the 2-year-old children.

Previous research suggested that sweetened beverages contribute heavily to the childhood overweight epidemic (3, 20). Half of the sample in this research study were either at risk for overweight or overweight, yet they did not consume high amounts of sweetened beverages. The overweight children consumed negligible amounts of soft drinks, and approximately 1/3 cup of sweetened fruit drinks and tea per day. Therefore, the cause of overweight among this group of children is due to something other than sweetened beverages. This finding agrees with that of O'Connor et al. (2006). Increased beverage consumption increased the total energy intake of preschool children, but had no effect on weight status or BMI. However, in this study overweight children did consume more 100% juice.

The major differences between weight groups was the number of servings eaten of vegetables, 100% juice, and desserts and sweets. Previous research on children aged 2-5 found no differences between weight groups with respect to 100% juice (21). Normal, at risk for overweight, and overweight children all consumed an average of 4.7 fluid ounces of fruit juice, which was considered to be an appropriate amount (21). Overweight children consumed a higher number of servings of desserts. Chocolate syrup was a common dessert consumed by these children because it was added to their milk. This may lead children to prefer sweet items, and may not drink plain milk in the future. Overweight children were eating increased amounts of all food, and therefore their average intake resulted in meeting and/or exceeding all nutrient requirements.

Children met the recommended intakes for most of the food groups and nutrients. The exceptions were fruits, vegetables, fat, and dietary fiber. The finding that these children are not meeting their fruit and vegetable needs is consistent with previous research. Children consumed approximately 1 serving of both fruits and vegetables per day compared to the recommended 2 servings. However, if 100% juice was included in the fruit group, the children would have met the recommendations for fruit. Dennison et al. (1998) reported that children aged 2 to 5 years did not meet the recommendations for fruits and vegetables. In that study, children consumed less than ½ serving per day of vegetables, and less than 1 serving of fruits. Inadequate fruit and vegetable intake could lead to nutrient deficiencies and increased consumption of total and saturated fat (4); however, that was not evident in our findings. Dennison et al. (1998) also reported that 50% of fruit intake was due to fruit juice consumption. In our study, the number of

servings of 100% juice was similar to the number of servings consumed of fruit, suggesting that they received half of their fruit intake from 100% juice.

The adequate nutrient intake of this population may have been due to the increased consumption of fortified cereals, and other fortified meals and snacks such as "Gerber Graduate" products. Fox et al. (2006) had similarly reported that fortified foods and supplements contributed greatly to the intakes of certain and vitamins and minerals in toddlers. In our study, the decreased consumption of fruits and vegetables may be contributing to the low fiber intake. Children consumed 8-10g of fiber compared to the recommended 19g. Dennison et al. (1998) also reported a significant correlation between dietary fiber intake and total fruit and vegetable consumption.

The normal weight children consumed more kilocalories than recommended for their age, but could be more physically active as they are consuming more kilocalories per kg body weight but retained a lower BMI. The children who were at risk for overweight consumed less for most food groups and nutrients than both the normal weight and overweight children. This finding suggests that the parents of these at risk for overweight children may be restricting their intake. They may have noticed that their child was heavier and were taking action to prevent excess weight gain.

Limitations

There are several limitations to this research. Such limitations include the inherent ones when conducting 24-hour dietary recalls. The data may not be completely accurate due to over/under-reporting by the mothers. This type of dietary assessment relies on memory, sometimes making it difficult for the participant. Since the mother

was providing the information, they may not have been fully aware of what their child ate. Participants may have reported what was put on their child's plate as opposed to what their child actually consumed. If the 2-year-old child attended daycare, the provided daycare forms may not have been adequate enough to get a complete account of what the child consumed while at daycare. Additionally, several participants only completed one dietary recall, which may not be representative of what their child usually eats.

Conclusions

These results can provide guidance for dietetic and health professionals, parents, and caregivers about appropriate foods to prevent weight gain during childhood, focusing on children 2 years of age. In 2-year-olds, sweetened beverages such as tea or soda may not be to blame for the high rates of overweight. Desserts and sweets and 100% juice can contribute to overweight, and therefore should be consumed in small amounts. Special attention should be placed on decreasing the addition of chocolate syrup to milk. Efforts to increase fruit and vegetable consumption should be taken into consideration. The decreased fruit and vegetable consumption by the 2-year-olds resulted in a deficient fiber intake. Parents and caregivers should be educated on appropriate foods and serving sizes for their 2-year-old children.

Future research

When designing intervention studies to prevent childhood overweight in 2-year-olds, researchers may want to focus specifically on 100% juice and desserts to determine the effect that these food items can have on childhood overweight. Future research should also assess the barriers involved with children eating less than the recommended

amounts of fruits and vegetables. Finally, both physical activity and dietary intake should be compared between normal weight and overweight children.

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TABLES

Table 3.1 Participant Characteristics by Child Weight Category

Maternal Characteristic	Normal Weight (n=134)	At Risk for Overweight (n=56)	Overweight (n=53)	P-value
Race (%)				0.68[1]
White	50.7	53.6	45.3	
African American/other	49.3	46.4	54.7	
Age (%)				0.73[1]
< 30 years	41	41.1	47.2	
> 30 years	59	58.9	52.8	
Marital Status (%)				0.57[1]
Single, never married	17.2	23.2	15.1	
Living with partner	10.4	7.1	9.4	
Married	69.4	69.6	71.7	
Divorced/separated	3.0	0	3.8	
Education (%)				0.52[1]
≤ High school	13.4	21.4	18.9	
Associate degree	26.9	17.9	24.5	
College degree	59.7	60.7	56.6	
Income (%)				0.86[1]
Up to $30,000	27.1	23.1	29.4	
$30,001-$60,000	31.6	28.8	25.5	
$60,001 or more	41.4	48.1	45.1	
2 yr Postpartum BMI (kg/m^2; mean ± SD)	32.7 ± 7.4	31.6 ± 6.2	34.2 ± 8.9	0.20[2]
Child Characteristic				
Gender (%)				0.95[1]
Male	53	55.4	54.7	
Female	47	44.6	45.3	
Birth weight (kg; mean ± SD)	3.3 ± 0.6	3.4 ± 0.4	3.5 ± 0.5	0.08[2]
BMI at 2 yrs (kg/m^2; mean ± SD)	16.1 ± 0.8	17.5 ± 0.3	19.1 ± 1.0	<0.0001[2]

[1]P-value for χ^2 analyses
[2]P-value for ANOVA analyses
$p \leq 0.05$
Normal weight: defined as having a BMI ≤ 85th percentile
At Risk for Overweight: defined as having a BMI 85-94.9 percentile
Overweight: defined as having a BMI ≥ 95th percentile

Table 3.2 Average Number of Food Group Servings Consumed by Normal weight, At Risk for Overweight, and Overweight 2-year-old Children			
Food Groups (serving size*)	**Normal weight (n=134)**	**At Risk for Overweight (n=56)**	**Overweight (n=53)**
Fruit (1/2 cup)	1.12 ± 0.94	1.12 ± 1.05	1.15 ± 1.06
Vegetables (1/2 cup)			
Vegetables	0.74 ± 0.66	0.59 ± 0.56	0.88 ± 0.75
Fried Potatoes	0.12 ± 0.24	0.08 ± 0.18	0.13 ± 0.30
Legumes	0.05 ± 0.16	0.03 ± 0.12	0.03 ± 0.12
Starchy vegetables	0.23 ± 0.36	0.22 ± 0..39	0.27 ± 0.43
Grains (1/2 cup, 1 slice bread)			
Whole wheat & some whole wheat grains	0.82 ± 0.82	0.75 ± 0.75	0.78 ± 0.90
Refined grains	2.20 ± 1.44	2.10 ± 1.40	2.60 ± 1.34
Snack chips	0.17 ± 0.31	0.15 ± 0.33	0.30 ± 0.65
Protein (1 oz)			
Regular & lean beef & pork	0.50 ± 0.77	0.48 ± 0.77	0.60 ± 0.84
Regular & lean poultry	1.24 ± 1.27	1.14 ± 1.39	1.21 ± 1.20
Fish	0.26 ± 0.99	0.15 ± 0.45	0.17 ± 0.99
Cold cuts & sausage	0.44 ± 0.70	0.62 ± 0.80	0.44 ± 0.78
Egg (1)	0.21 ± 0.47	0.20 ± 0.38	0.27 ± 0.59
Nuts & seeds (1/2 oz)	0.17 ± 0.39	0.22 ± 0.44	0.20 ± 0.49
Dairy (1 cup)			
Milk-whole & reduced fat	1.40 ± 1.16	1.40 ± 1.13	1.32 ± 1.00
Milk-low fat & skim	0.24 ± 0.68	0.25 ± 0.62	0.26 ± 0.65
Cheese (1/2 oz)	0.34 ± 0.42	0.40 ± 0.41	0.43 ± 0.52
Yogurt	0.11 ± 0.25	0.14 ± 0.24	0.11 ± 0.20
Fats (1 tsp)	1.13 ± 1.05	0.91 ± 0.89	1.10 ± 1.06
Beverages			

100% juice (4 oz)	1.53 ± 1.60	1.14 ± 1.73	1.90 ± 1.85
Regular soft drinks (1 cup)	0.03 ± 0.11	0.03 ± 0.14	0.005 ± 0.04
Diet soft drinks, unsweetened tea (1 cup)	0.04 ± 0.15	0.12 ± 0.52	0.06 ± 0.34
Sweetened fruit drinks & tea (1 cup)	0.30 ± 0.54	0.20 ± 0.33	0.36 ± 0.72
Desserts & Sweets** Sweet Sauces e.g. chocolate syrup (2 TB) Candy, Brownie (40g) Cookie (30g) Pies, Pastries (125g)	0.35 ± 0.47 [a, b]	0.30 ± 0.50 [b]	0.55 ± 0.72 [a]
Fast food (# of times)	0.56 ± 0.79	0.63 ± 0.95	0.45 ± 0.72

Mean ± SD
*Serving sizes determined by Nutrition Data System for Research (NDSR)
**$p \leq 0.05$
[a, b] Tukeys-Kramer HSD for variables significantly different from each other, $p \leq 0.05$
At Risk for Overweight: defined as having a BMI 85-94.9 percentile
Overweight: defined as having a BMI $\geq 95^{th}$ percentile
Overweight: defined as having a BMI $\geq 95^{th}$ percentile

Table 3.3 Amount of Nutrients Consumed by Normal weight, At Risk for Overweight, and Overweight 2-year-old children				
Nutrients	**Normal weight (n=134)**	**At Risk for Overweight (n=56)**	**Overweight (n=53)**	**Recommended Intake****
Energy (kcal)*	1258.2 ± 335.8 [a]	1142.0 ± 229.6 [b]	1302.9 ± 310.8 [a]	1046
Kcal/kg body weight*	106.4 ± 30.8 [a]	86.9 ± 17.9 [b]	89.6 ± 24.4 [b]	
Carbohydrate (g)*	169.6 ± 47.6 [a]	149.5 ± 31.8 [b]	179.9 ± 53.9 [a]	130
% calories from carbohydrate	54.2 ± 7.53	53.0 ± 8.40	55.3 ± 9.06	
Protein (g)	49.3 ± 14.8	47.9 ± 13.1	50.2 ± 16.4	13 or 1.1 g/kg
% calories from protein	15.9 ± 3.30	16.7 ± 3.47	15.5 ± 4.33	
Fat (g)	44.5 ± 16.2	41.0 ± 14.4	44.7 ± 14.2	
% calories from fat	31.4 ± 6.05	31.6 ± 6.89	30.7 ± 6.86	
Trans-fatty acids (g)	3.10 ± 1.70	2.74 ± 1.55	3.15 ± 1.76	
% calories from SFA	11.8 ± 3.44	12.3 ± 3.56	11.4 ± 3.07	
% calories from MUFA	11.5 ± 2.64	11.3 ± 2.74	10.9 ± 2.62	
% calories from PUFA	5.30 ± 1.93	5.24 ± 1.75	5.63 ± 3.25	
Omega-3 Fatty acids (g)	0.85 ± 0.51	0.70 ± 0.32	0.78 ± 0.27	
Cholesterol (mg)	153.1 ± 106.6	152.2 ± 93.4	164.2 ± 133.6	
Dietary Fiber (g)*	9.10 ± 3.50 [a,b]	8.01 ± 2.94 [b]	9.77 ± 3.77 [a]	19
Total Sugars (g)	92.1 ± 29.9	82.5 ± 25.8	96.0 ± 36.5	
Added Sugars (g)	36.1 ± 25.8	30.24 ± 15.9	36.5 ± 26.8	
Calcium (mg)	833.4 ± 351.1	862.1 ± 332.6	847.1 ± 370.8	500
Vitamin D (mcg)	5.60 ± 2.96	5.44 ± 2.83	5.17 ± 2.47	5
Folate (mcg)*	252.7 ± 117 [a,b]	220.1 ± 91.2 [b]	281.9 ± 145 [a]	150
Thiamin (vitamin B1) (mg)*	1.11 ± 0.42 [a,b]	0.98 ± 0.28 [b]	1.15 ± 0.40 [a]	0.5
Riboflavin (vitamin B2) (mg)	1.73 ± 0.64	1.66 ± 0.51	1.72 ± 0.57	0.5
Niacin (Vitamin B3) (mg)	13.0 ± 4.60	11.6 ± 4.40	13.1 ± 4.70	6
Vitamin B6 (mg)	1.18 ± 0.42	1.08 ± 0.30	1.25 ± 0.50	0.5
Vitamin B12 (mcg)	4.33 ± 5.61	3.58 ± 1.40	3.73 ± 1.90	0.9
Vitamin C (mg)*	74.13 ± 66.0 [a,b]	57.7 ± 46.3 [b]	88.3 ± 74.4 [a]	15
Vitamin K (mcg)*	48.8 ± 55.6 [a,b]	35.9 ± 28.5 [b]	63.5 ± 75.2 [a]	30

Vitamin E (mg)	5.54 ± 5.02	4.02 ± 1.63	5.17 ± 3.04	6
Vitamin A (mcg)	530.4 ± 336.7	493.7 ± 198.1	508.6 ± 270.8	300
Sodium (mg)	1783.1 ± 608.9	1678.3 ± 510.4	1891.4 ± 632.3	1000
Iron (mg)*	9.52 ± 4.2 **a,b**	8.38 ± 3.40 **b**	10.7 ± 5.11 **a**	7
Zinc (mg)	6.9 ± 2.60	6.65 ± 2.20	7.26 ± 3.20	3

* $p \leq 0.05$
** Dietary Reference Intakes, National Academy of Sciences, Institute of Medicine Food and Nutrition Board.
a, b Tukeys-Kramer HSD for variables significantly different from each other, $p \leq 0.05$
Normal weight: defined as having a BMI $\leq 85^{th}$ percentile
At Risk for Overweight: defined as having a BMI 85-94.9 percentile
Overweight: defined as having a BMI $\geq 95^{th}$ percentile

CHAPTER IV

PREDICTORS OF BODY MASS INDEX OF 2-YEAR-OLD CHILDREN BORN TO OVERWEIGHT/OBESE WOMEN

Introduction

The prevalence of overweight among toddlers and children has increased over the years and will continue to increase (1). The increased prevalence of overweight among children will result in several medical and psychosocial consequences (2). Additionally, overweight results in increased health care costs (1).

There are many predisposing factors that may put a child at risk for becoming overweight or obese. Those factors include race, education, income, maternal body mass index (BMI), and birth weight (3, 4). Different ethnic and racial groups such as Hispanics (3), Mexican Americans, and non-Hispanic Blacks (5) tend to experience higher rates of overweight and obesity than others. Furthermore, parents and/or families with a low income and/or educational level often do not have the knowledge or means to provide healthy food for their families (4, 6-8). If the mother has a high BMI, then the child has a higher risk of becoming overweight (4, 6-10).

Breastfeeding may also have an effect on childhood overweight and obesity. Possible mechanisms for this protective effect include both behavioral and hormonal aspects. Children who breastfeed are able to regulate their own intake (11), which could possibly set the stage for appropriate regulation through infancy and childhood. Also,

protein intakes tend to be lower in children who are breastfed, and it has been hypothesized that higher protein intakes early in life result in overweight later in life (12). Infants who are bottle-fed have also shown higher plasma insulin levels, which could stimulate fat deposition and lead to early development of adipocytes (12).

Several researchers have evaluated the relationship between duration of breastfeeding and the risk of overweight among children. In general, as breastfeeding duration increases, the child's risk of becoming overweight decreases (3, 6-8, 13-27); however, some researchers believe that the overweight epidemic among children is due to lifestyle factors such as physical activity and dietary habits (9, 28). It is recommended by the American Academy of Pediatrics (AAP) for mothers to breastfeed exclusively for at least 12 months (29). This will likely provide a protective effect, as some researchers have suggested that breastfeeding for at least 3 or 4 months can reduce the risk of overweight (7, 17).

There is currently an extensive amount of research that has been conducted on the major predictors of child body mass index (BMI). However, many of these studies have been conducted on school-aged children. In addition, none were solely conducted on children whose mothers were overweight or obese prior to pregnancy. The purpose of this study was to determine the major predictors of the BMI of 2-year-old children who were born to overweight/obese mothers. These findings can be used to guide the development of intervention programs targeting ways in which parents can decrease the child's risk of becoming overweight.

Methods

Participants

Participants were recruited from the Active Mothers Postpartum (AMP) study (30). The AMP study was a two-arm randomized trial of 450 women who were overweight or obese prior to pregnancy. The purpose of the AMP study was to promote weight loss in postpartum women who were overweight or obese prior to pregnancy. At 2 months postpartum, the women were randomized to a minimal care group or the intervention group. The minimal care group received monthly "healthy tips" newsletters, while the intervention group had the opportunity to participate in physical activity sessions, nutrition education sessions, and counseling calls for nine months. At the 2-year postpartum visit for the AMP study, participants were recruited for the AMP too for Twos! Study. The purpose of the AMP too for Twos! study was to understand how family and child factors relate to postpartum weight retention, as well as to evaluate how the child's BMI is affected by these factors. At this time, the participant gave written informed consent (Appendix C). This protocol was approved by the Institutional Review Boards of Duke University and the University of North Carolina at Greensboro.

Measurements/Surveys

Participants were surveyed at approximately 8 weeks postpartum, 12 months postpartum, and 2 years postpartum during the AMP study. Baseline information included age, race, education, income, marital status, parity, and gestational weight gain. Body mass index information was obtained for these participants at three different time points during the AMP study; pre-pregnancy, baseline, and 12 and 24 months postpartum.

At 12 months, mothers were asked how they fed their infants during the past year. For each month during the first year postpartum, women reported whether they exclusively breastfed, combined formula and breast milk, or exclusively formula fed their infant. Each response was assigned a value: 0=formula fed, 1=combined, 2= exclusively breastfed. Each value was then totaled for each of the 12 months to determine a lactation score. Scores ranged from 0 to 24. Participants were assigned to a breastfeeding group based on their lactation score. Participants with a lactation score of 0-11 were placed in the low intensity/duration of breastfeeding group, and those with a lactation score of 12-24 were placed in the high intensity/duration of breastfeeding group. The breastfeeding groups were created because there was not a linear relationship between lactation score and child BMI (R^2= 0.006). Based on previous research, it is suggested that at least 3 to 6 months of breastfeeding is needed to see an effect on the child's BMI. The lactation scores are also not evenly distributed among participants, as seen in Table 1.

At the 24 month postpartum visit, both mother's and child's weight and height were measured using a Tanita BWB-800 scale (Arlington Heights, IL) and a Seca 214 Portable Stadiometer (Columbia, MD). Participants took their shoes off and wore light clothing during the measurements. From these measurements, the body mass index (BMI) for both mother and child were calculated.

Within the following month, two 24-hour dietary recalls were obtained from the mother for their 2-year-old children using the Nutrition Data System for Research (NDSR) software version 2007, developed by the Nutrition Coordinating Center (NCC), University of Minnesota, Minneapolis, MN. If children attended daycare, mothers gave

the daycare provider a form to record the dietary intake (Appendix A). Daycare providers were instructed to write down what and how much was consumed by the children. Mothers used this list to complete the 24-hour recall. Mothers were contacted within 2 months of the baseline visit.

The child growth standards of the World Health Organization (WHO) were used to determine BMI z-scores of the children (31). These were released in April 2006 and are based on the growth of 8,440 children in the United States, Brazil, Ghana, India, Norway, and Oman. The children in the study were selected based on an optimal environment for proper growth. They were exclusively breastfed, had standard pediatric healthcare such as vaccinations, and their mothers did not smoke. The WHO growth standards were used rather than the CDC growth charts because the WHO growth standards depict how children should grow, given an optimal environment.

The BMI z-scores were used to divide the participants into three weight categories: normal weight, at risk for overweight, and overweight. For this analysis, children below the 85^{th} percentile (z-score = -1.64 to 1.03) were considered to be at a normal weight. Children between the 85^{th} and 94.9^{th} percentiles (z-score = 1.04 to 1.63) were considered to be at risk for overweight. Children at or above the 95^{th} percentile (z-score = $\geq$ 1.64) were considered to be overweight.

Statistical Analysis

Analysis was completed using JMP statistical software version 7.0 (SAS, Cary, NC). Chi-square and ANOVA were used to compare demographic characteristics between the normal weight, at risk for overweight, and overweight children. Stepwise

regression analysis was used to determine the predictors of the child's BMI at 2 years of age. Variables included the mother's age, race, education, marital status, 2 year postpartum BMI, gender of the child, birth weight, breastfeeding group, and whether or not the mothers were in the intervention or control arm of the AMP study. Using stepwise regression analysis, the data was first analyzed using the participants for whom breastfeeding data was available.

Food group and nutrient analysis from the 24-hour recall data was conducted. Those food groups with a p-value ≤ 0.10 were chosen in order to include all possible predictor variables into the model. The results revealed that the number of servings of vegetables, 100% juice, and desserts eaten were different between the normal weight, at risk for overweight, and overweight children (see previous chapter). Overweight children consumed a higher number of servings from each of these food groups. Therefore, vegetables, 100% juice, and desserts were included as variables in a second stepwise regression analysis, in addition to the mother's age, race, education, marital status, 2 year post partum BMI, gender of the child, birth weight, breastfeeding group, and whether or not the mothers were in the intervention or control arm of the AMP study. The final model included those variables with significance ≤ 0.25.

Results

Demographic Information

The total sample for the AMP too for Twos! study was n=304, but this analysis included only those that provided infant feeding history for the first year of life (n=288).

Participants with infant feeding information had a higher birth weight, and had mothers who had a higher education and income level, and a higher percentage who were married compared to those who did not provide infant feeding information. Within this sample, race was an evenly distributed between White and African American. Other races included were 1.7% Asian and 2.7% "other". The majority of the mothers were older than 30 years of age, were married, had a college education, and had an income of $60,001 or more. The mean body mass index (BMI) at 2 years postpartum was 32.8 ± 7.3 kg/m^2. The mean birth weight of the children was 3.4 ± 0.6 kg/m^2, and the mean BMI at 2 years of age was 17.2 ± 1.7 kg/m^2. Among the children, approximately 56% were male. Sixty four percent reported low intensity/duration, while 36% reported high intensity/duration of breastfeeding.

The mean BMI of the child at 2 years of age is displayed according the demographic characteristics in Table 2. Children had a higher BMI if their mothers were of African American/other race, single or divorced/separated, had a high school degree or less, had an income up to $30,000, or breastfed with a low intensity/duration. Males had a higher BMI than females.

The participant characteristics according to weight category are presented in Table 3. Of the 288 participants, 22% of the children were at risk for overweight, and 25% were overweight according to the WHO growth standards. Three children were underweight (BMI z-score < -1.64) and were included in the normal weight group for analysis. In comparison, according to the CDC growth charts, 16.1% of children in this population were considered to be overweight, and 10.4% of children were considered to

be obese. Therefore, approximately 26.5% of children were overweight or obese. The overweight children (BMI $\geq 95^{th}$ percentile) had mothers with a higher 2 year postpartum BMI (p=0.21). The overweight children also had higher birth weights (p=0.02) than the normal weight and at risk for overweight children.

Predictors of BMI

Stepwise regression analysis revealed significant predictors of the BMI of the 2-year-old children, which are presented in Tables 4 and 5. For the first analysis, variables entered included mother's age, race, education, marital status, gender of the child, birth weight, breastfeeding group, and whether or not the mothers were in the intervention or control arm of the AMP study. Due to missing birth weight information, this analysis included 278 participants. Maternal education, gender, birth weight, mother's 2 year postpartum BMI, and breastfeeding accounted 10% of the variance in child's BMI at 2 years of age. However, breastfeeding group and mother's 2 year postpartum BMI were not significant predictors (p=0.13 and p=0.07, respectively). The most significant predictor of BMI was birth weight (p=0.003). Females had a lower BMI than the males. An increase in the birth weight of the child and in the mother's 2 year postpartum BMI resulted in an increase in the BMI of the child at 2 years. Higher education resulted in a decrease in BMI of the child at 2 years. Lastly, high intensity/duration of breastfeeding resulted in a decrease in BMI. The interaction between race and breastfeeding group and its effect on child's BMI was examined but was not significant.

The analysis was then conducted with those participants that provided dietary information (n=226). The same characteristic variables were entered along with

consumption of 100% juice, vegetables, and desserts. In this analysis, breastfeeding group was significant (p=0.04). Gender of the child, birth weight, mother's 2 year postpartum BMI, desserts, breastfeeding, and education accounted for 11% of the variance in child's BMI at 2 years of age. However, mother's 2 year postpartum BMI (p=0.07), education (p=0.12), and desserts (p=0.09) were not significant. The most significant predictor for this analysis was birth weight of the child (p=0.02). Females, children of mother's with a higher education, and those that were breastfed with a high intensity/duration had a lower BMI at 2 years of age. An increase in birth weight, the higher the BMI of the mother at 2 years postpartum, and a higher consumption of desserts resulted in an increase of the BMI of the child at 2 years of age.

Discussion

The most significant predictors of the child's BMI were birth weight, gender, mother's 2 year postpartum BMI, maternal education, and breastfeeding group. These findings are consistent with previous research. When looking at 4.5-year-olds, children who were born with a higher birth weight and those that gained the most weight in the first five months were more likely to be overweight (4). In children at the age of 4, it was shown that a high birth weight and being male were risk factors for childhood overweight (3). At age 2, birth weight is a strong predictor of BMI. It could be that at this age the birth weight is still an important factor. As the child gets older, other environmental and lifestyle factors may be stronger predictors of BMI. Such factors may include breastfeeding, diet, and physical activity. Several research studies have shown that

maternal BMI has an effect on the BMI of the child (6-10). Dubois et al. suggested that the maternal weight status increased the risk of overweight in children. When the mother is considered to be overweight, the child's risk of overweight tripled. That risk quadrupled when the mother was obese (9). Additionally, children of low-income families experienced an even greater risk if their mother had a higher BMI (4). Children whose parents are poorly educated may experience an increased risk of becoming overweight (7, 8).

Approximately 47% of the children were either at risk for overweight or overweight at 2 years of age, with 25% being overweight. NHANES 2003-2004 reported an overweight prevalence among children aged 2-5 to be 13.9% (32). This high prevalence of overweight is concerning and is possibly due to high birth weights and maternal BMI of our participants.

While not statistically significant in the first stepwise regression analysis, breastfeeding group did remain in the model. In the second stepwise regression analysis, which included the diet, breastfeeding group was significant. Breastfeeding has been though to have a protective effect against overweight. A high intensity/duration of breastfeeding resulted in a reduction in BMI at 2 years of age (β coefficient = -0.41). Weyermann et al. studied this association in 2-year-olds in Germany, and the risk for overweight among the children that were breastfed for 6 months was lower than those that were breastfed for 3 months. This was the only study conducted on only 2-year-olds. Several other studies on school-aged children and adolescents have shown that with increased breastfeeding duration, there is a reduced risk of overweight (3, 6-8, 13-27). In

addition, the lack of breastfeeding combined with maternal overweight/obesity is thought to be an additive interaction (8). In this study, both breastfeeding and mother's 2-year postpartum BMI predicted child BMI. Therefore, overweight mothers may need to be targeted for additional breastfeeding support to lessen their child's risk of becoming overweight.

Our finding that high intensity/duration of breastfeeding resulted in a reduction in child BMI is important, because breastfeeding is a modifiable factor. The sex of the child or the level of the mother's education cannot be changed; however, the mother can decide to breastfeed to lessen her child's risk of becoming overweight. It is recommended by the American Academy of Pediatrics that infants be exclusively breastfed for at least 12 months, and to continue breastfeeding beyond the first year (29). According to the National Immunization Survey (2004), the percent of children breastfed at birth, 6 months, and 12 months continues to increase in the United States. If breastfeeding rates continue to rise and breastfeeding promotion is encouraged, then more children will be at a reduced risk for overweight.

Differences between weight groups with respect to the dietary intake as seen in the previous manuscript included the number of servings eaten of vegetables, 100% juice, and desserts. Increased consumption of desserts is related to an increased BMI at 2 years of age. Serving size amounts for desserts include 30g cookie, 40g brownie and candy, 125g pies and pastries, and 2TB sweet sauces e.g chocolate sauce. In contrast, previous research has suggested that sweetened beverages play a large role in childhood overweight (34, 35). Dubois et al. (1997) reported that 6.9% of children who did not

consume sweetened beverages between meals were overweight, compared to 15.4% of children who did consume these beverages. Children that consumed more than 12 fl. oz. of juice/day were more overweight than those who consumed less (34). The association between dessert consumption and childhood overweight has not been previously reported. This finding is important because dessert consumption is another modifiable factor. Parents can be educated on proper child nutrition practices, such as limiting desserts, so that their children do not gain excess weight at an early age.

Limitations

A possible limitation of this research is the retrospective breastfeeding data. Mothers were asked at 1 year postpartum about their infant feeding practices for each of the previous 12 months. An alternative to this approach would be asking the mothers after each month. However, retrospective data collection of breastfeeding has been shown to be valid and reliable. Mothers become less accurate at recalling their breastfeeding durations as time passes, but a recall period of at least 3 years is effective (36).

Other limitations include the inherent ones when conducting 24-hour dietary recalls. The data may not be completely accurate due to over/under-reporting by the mothers. This type of dietary assessment relies on memory, sometimes making it difficult for the participant. Since the mother was providing the information, they may not have been fully aware of what their child ate. Participants may have reported what was put on their child's plate as opposed to what their child actually consumed. If the 2-year-old child attended daycare, the provided daycare forms may not have been adequate

enough to get a complete account of what the child consumed while at daycare. Additionally, several participants only completed one dietary recall, which may not be representative of what their child usually eats.

Conclusion

These results can provide guidance for dietetics and other healthcare professionals, parents, and caregivers about factors that place a child at an increased risk for childhood overweight. Some of those factors such as education, gender, and birth weight cannot be changed; however, both diet and breastfeeding duration are modifiable factors and should be emphasized in childhood overweight/obesity intervention programs. Breastfeeding promotion and support should take place pre-and postnatally. With an increased duration of breastfeeding, the child may be less likely to become overweight. Educating parents and caregivers about appropriate foods and servings sizes that should be given to 2-year-olds is important. Certain foods, mainly desserts such chocolate syrup and cookies, may result in childhood weight gain.

Future Research

Future research should focus on determining the mechanisms by which breastfeeding can reduce a child's risk of becoming overweight. The ability of the breastfed child to regulate their own intake and other metabolic programming hypotheses should be studied. Additional research on preschool-aged children is needed. Determining the significant predictors of child's BMI at several different life stages would be helpful in order to tailor interventions to different age groups.

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TABLES

Table 4.1 Lactation Score Distribution	
Lactation Score	**Participants (%)**
0	29.9
1	4.9
2	5.2
3	2.4
4	1.0
5	3.8
6	3.1
7	4.9
8	1.7
9	2.4
10	2.8
11	2.8
12	4.5
13	3.8
14	1.7
15	2.1
16	1.7
17	2.1
18	2.4
19	0.7
20	0.7
21	0.7
22	0.7
23	1.0
24	12.8

Table 4.2 Average BMI of Child According to Demographic Characteristic	
Maternal Characteristic (n)	**BMI of Child at 2 years (kg/m^2; mean ± S.D.)**
Race	
White (141)	17.1 ± 1.21
African American/other (147)	17.3 ± 2.08
Age	
< 30 years (121)	17.2 ± 1.44
> 30 years (167)	17.2 ± 1.90
Marital Status	
Single, never married (54)	17.5 ± 2.40
Living with partner (29)	17.0 ± 1.50
Married (196)	17.1 ± 1.50
Divorced/separated (9)	17.7 ± 1.78
Education	
≤ High school (53)	17.8 ± 2.46
Associate degree (73)	17.0 ± 1.76
College degree (162)	17.1 ± 1.31
Income	
Up to $30,000 (79)	17.4 ± 2.30
$30,001-$60,000 (80)	16.9 ± 1.44
$60,001 or more (121)	17.2 ± 1.43
Breastfeeding Group	
Low intensity/duration (187)	17.3 ± 1.90
High intensity/duration (101)	17.0 ± 1.41
Gender of Child	
Male (162)	17.4 ± 1.84
Female (126)	17.0 ± 1.50

Table 4.3 Demographic Characteristics by Child Weight Category				
Maternal Characteristic	**Normal Weight (n=155)**	**At Risk for Overweight (n=62)**	**Overweight (n=71)**	**P-value**
Race (%)				0.58[1]
White	50.3	51.6	43.7	
African American/other	49.7	48.4	56.3	
Age (%)				0.82[1]
< 30 years	40.6	41.9	45.1	
> 30 years	59.4	58.1	54.9	
Marital Status (%)				0.78[1]
Single, never married	17.4	24.2	16.9	
Living with partner	10.3	9.7	9.9	
Married	69.7	64.5	67.6	
Divorced/separated	2.6	1.6	5.6	
Education (%)				0.46[1]
≤ High school	14.8	21.0	23.9	
Associate degree	27.7	21.0	23.9	
College degree	57.4	58.1	52.1	
Income (%)				0.65[1]
Up to $30,000	27.9	27.6	29.4	
$30,001-$60,000	37.8	27.6	22.1	
$60,001 or more	40.3	44.8	48.5	
2 yr Postpartum BMI (kg/m^2; mean ± SD)	32.7 ± 6.9	31.8 ± 6.1	34.0 ± 8.7	0.21[2]
Breastfeeding Group (%)				0.62[1]
Low intensity/duration	62.6	66.1	69.0	
High intensity/duration	37.4	33.9	31.0	
Child Characteristic				
Gender (%)				0.95[1]
Male	55.5	56.5	57.7	
Female	44.5	43.5	42.3	
Birth weight (kg; mean ± SD)	3.3 ± 0.7	3.4 ± 0.5	3.5 ± 0.5	0.02[2]
BMI at 2 yrs (kg/m^2; mean ± SD)	16.1 ± 0.8	17.5 ± 0.3	19.3 ± 1.8	<0.0001[2]

[1]P-value for χ^2 analyses
[2]P-value for ANOVA analyses
Normal weight: defined as having a BMI ≤ 85th percentile
At Risk for Overweight: defined as having a BMI 85-94.9 percentile
Overweight: defined as having a BMI ≥ 95th percentile
Breastfeeding group: A lactation score was calculated, and those with a lactation score from 0-

11 was classified as low intensity/duration of breastfeeding, while a score of 12-24 was classified as high intensity/duration.

Table 4.4 Predictors of BMI at 2 years of Age (n=278)		
Intercept 15.28 kg/m^2		
Variable	**Estimate**	**P-value**
Sex of Child		0.04
Male (reference)	0	
Female	-0.42	
Birth weight of Child (kg)	0.50	0.003
Mother 2yr PP BMI (kg/m^2)	0.03	0.07
Education		0.05
≤ High School (reference)	0	
Associate Degree	-0.73	
College Graduate	-0.57	
Breastfeeding Group		0.13
Low intensity/duration (reference)	0	
High intensity/duration	-0.33	

Table 4.5 Predictors of BMI at 2 years of Age with Diet Information (n=226)		
Intercept 15.46 kg/m^2		
Variable	**Estimate**	**P-value**
Sex of Child		0.05
Male (reference)	0	
Female	-0.37	
Birth weight of Child (kg)	0.39	0.02
Mother 2yr PP BMI (kg/m^2)	0.03	0.07
Education		0.12
≤ High School (reference)	0	
Associate Degree	-0.62	
College Graduate	-0.32	
Breastfeeding Group		0.04
Low intensity/duration (reference)	0	
High intensity/duration	-0.41	
Desserts (# of servings)	0.30	0.09

CHAPTER V

EPILOGUE

I began my research at UNCG the first semester that I arrived. At the time, Dr. Lovelady and a doctoral student had been working on the Active Mothers Postpartum (AMP) study with Duke University. The Active Mothers Postpartum Too For Twos! Study was an ancillary study to the AMP study. The participants involved with AMP Too for Twos were the 2-year-old children of the overweight mothers that participated in the AMP study. AMP Too for Twos was just beginning, so it was my job to conduct 24-hour recalls on the two-year old children. I immediately started training on the Nutrient Data System for Research (NDSR), which is provided by the Nutrition Coordinating Center at the University of Minnesota. After feeling comfortable enough with the NDSR, I began calling the mothers of the 2-year-old children to obtain 24-hour recalls. This data collection continued for approximately one and a half years.

Collecting the 24-hour recalls on these children was a great, eye-opening experience. It gave me insight as to how difficult it can sometimes be to work with human participants in a research study. It was also surprising to hear about what some of these children were eating. It was this that got me interested in analyzing the diets of these children.

Being that this study was ancillary to the AMP study, I had access to a wide variety of information on the mothers of these children. The breastfeeding information

was particularly appealing. Mothers were asked whether or not they breastfed their infants during the first year of life. I was interested in how the breastfeeding duration could be related to the child's body mass index. Other variables of interest from the AMP study included mother's race, age, education, income, and gestational weight gain.

With the diet information, and the variables from the AMP study, I was able to form a research question. I decided that I would determine the major predictors of BMI in 2-year-old children who were born to overweight mothers. In analyzing the diet, both food groups and nutrients were assessed. The number of servings eaten from each food group were compared to the MyPyramid for preschoolers, and the nutrient intakes were compared to the Dietary Reference Intakes in order to see whether or not the children were meeting the recommendations. A lactation score was calculated based on the breastfeeding information provided by the AMP study in order to determine whether or not breastfeeding duration plays a role in the BMI of the child.

This thesis research assessed the dietary intake of 2-year-old children born to overweight/obese mothers as well as the significant predictors of their BMI. This research also assessed the food group and nutrient intake differences between normal weight, at risk for overweight, and overweight children. The results of this research identified where children need to make improvements in their diet, which can help parents and caregivers. The results of this research also identified the factors involved in placing a child at an increased risk of becoming overweight. Although some of those factors cannot be changed, both the diet and breastfeeding duration are modifiable and should be emphasized in childhood overweight/obesity intervention programs. These

findings suggest that children born to overweight/obese mothers should increase their fruit and vegetable intake. In addition, breastfeeding should be promoted to overweight/obese mothers, as it may decrease the child's risk of becoming overweight.

Additional information that would be helpful in analyzing this data would be physical activity. Physical activity could be an important factor in whether or not a child will become overweight. The normal weight children in this sample consumed more kilocalories per kilogram body weight, suggesting that they may be more physically active which is why they have maintained a normal weight. The new MyPyramid for Preschoolers recommends that preschoolers get at least sixty minutes of physical activity every day. Those sixty minutes do not have to be completed all at once. The survey given to the mothers for the AMP too for Twos! study included questions about their toddlers physical activity. The questions given assess the amount of time the toddler spends outdoors on a typical weekday and weekend day. The survey also includes questions regarding the amount of television the toddler watches. A future analysis with the AMP too for Twos! data could incorporate the physical activity questionnaire items to see whether or not it has an impact on their BMI.

The AMP too for Twos! survey also incorporated questions involving the child's eating behaviors and the parental feeding style. The eating behaviors of the child along with the parental feeding styles could have an affect on the child's BMI. A future analysis with this information may also be helpful in determining the predictors of child BMI.

APPENDIX A. DAYCARE FORM

Food & Beverage Intake for _____

Date _____

Please include the time that the child ate or drank and what meal it was; breakfast, lunch, snack, etc. List the foods and beverages that the child had, along with the exact amount that the child consumed. Also, specify brand names if they are available. Remember, we only need to know what the child actually ate or drank – not what he/she was served.

Attention Mothers – Please review after completed by the daycare to make sure that amounts and brand names if available are provided.

Time_____ Meal _____

Food or Beverage **Amount eaten or drank**

_____ _____

_____ _____

_____ _____

_____ _____

_____

Time_____ Meal _____

Food or Beverage **Amount eaten or drank**

_____ _____

_____ _____

_____ _____

_____ _____

_____

Time_____ Meal _____

Food or Beverage **Amount eaten or drank**

_____ _____

_____ _____

_____ _____

_____ _____

_____ _____

Time_____ Meal _____

Food or Beverage **Amount eaten or drank**

_____ _____

_____ _____

_____ _____

_____ _____

_____

_____ _____

APPENDIX B: MOTHER'S SURVEY

Date: _____

Thank you again for agreeing to complete this survey. Please remember that your answers will remain confidential and you may refuse to answer any question.

*We are interested in finding out about the kinds of physical activities that people do as part of their everyday lives. The questions will ask you about the time you spent being physically active in the **last 7 days**. Please answer each question even if you do not consider yourself to be an active person. Please think about the activities you do at work, as part of your house and yard work, to get from place to place, and in your spare time for recreation, exercise or sport.*

---

*Think about all the **vigorous** activities that you did in the **last 7 days**. **Vigorous** physical activities refer to activities that take hard physical effort and make you breathe much harder than normal. Think only about those physical activities that you did for at least 10 minutes at a time.*

1. During the **last 7 days**, on how many days did you do **vigorous** physical activities like heavy lifting, digging, aerobics, or fast bicycling?

   ___ days per week (If no days, skip to #3)

2. How much time did you usually spend doing **vigorous** physical activities on one of those days?

   ___ hours and ___ minutes per day

*Think about all the **moderate** activities that you did in the **last 7 days**. **Moderate** activities refer to activities that take moderate physical effort and make you breathe somewhat harder than normal. Think only about those physical activities that you did for at least 10 minutes at a time.*

3. During the **last 7 days**, on how many days did you do **moderate** physical activities like carrying light loads, bicycling at a regular pace, or doubles tennis? Do not include walking.

   ___ days per week (If no days, skip to #5)

4. How much time did you usually spend doing **moderate** physical activities on one of those days?

   ___ hours and ___ minutes per day

*Think about the time you spent **walking** in the **last 7 days**. This includes at work and at home, walking to travel from place to place, and any other walking that you might do solely for recreation, sport, exercise, or leisure.*

5. During the **last 7 days**, on how many days did you **walk** for at least 10 minutes at a time?

___ days per week (If no days, skip to #7)

6. How much time did you usually spend **walking** on one of those days?

___ hours and ___ minutes per day

~~*The last question is about the time you spent **sitting** on weekdays during the **last 7 days**.*~~
Include time spent at work, at home, while doing course work and during leisure time. This may include time spent sitting at a desk, visiting friends, reading, or sitting or lying down to watch television.

7. During the **last 7 days**, how much time did you spend **sitting** on a week day?

___ hours and ___ minutes per day

8. Think about your eating habits over the past 12 months. About how often did you eat or drink each of the following foods? Remember breakfast, lunch, dinner, snacks, and eating out. **Check only one box for each food.**

TYPE OF FOOD	Never	Less than Once Per Month	1-3 Times Per Month	1-2 Times Per Week	3-4 Times Per Week	5-6 Times Per Week	1 Time Per Day	2 or More Times Per Day
a. Cold cereal	☐	☐	☐	☐	☐	☐	☐	☐
b. Skim milk, on cereal or to drink	☐	☐	☐	☐	☐	☐	☐	☐
c. Eggs, fried or scrambled in margarine, butter, or oil	☐	☐	☐	☐	☐	☐	☐	☐
d. Sausage or bacon, regular-fat	☐	☐	☐	☐	☐	☐	☐	☐
e. Margarine or butter on bread, rolls, pancakes	☐	☐	☐	☐	☐	☐	☐	☐
f. Orange juice or grapefruit juice	☐	☐	☐	☐	☐	☐	☐	☐
g. Fruit (not juices)	☐	☐	☐	☐	☐	☐	☐	☐
h. Beef or pork hot dogs, regular-fat	☐	☐	☐	☐	☐	☐	☐	☐
i. Cheese or cheese spread, regular-fat	☐	☐	☐	☐	☐	☐	☐	☐
j. French fries, home fries, or hash brown potatoes	☐	☐	☐	☐	☐	☐	☐	☐
k. Margarine or butter on vegetables, including potatoes	☐	☐	☐	☐	☐	☐	☐	☐
l. Mayonnaise, regular-fat	☐	☐	☐	☐	☐	☐	☐	☐
m. Salad dressings, regular-fat	☐	☐	☐	☐	☐	☐	☐	☐
n. Rice	☐	☐	☐	☐	☐	☐	☐	☐
o. Margarine, butter, or oil on rice or pasta	☐	☐	☐	☐	☐	☐	☐	☐

9. Over the past 12 months, when you prepared foods with margarine or ate margarine, how often did you use a reduced-fat margarine?

☐ Didn't use margarine
☐ Almost never
☐ About ¼ of the time
☐ About ½ of the time
☐ About ¾ of the time
☐ Almost always or always

10. Overall, when you think about the foods you ate over the past 12 months, would you say your diet was high, medium, or low in fat?

☐ High ☐ Medium ☐ Low

Now we would like to ask you some questions about your partner and your toddler (your child that was born about 2 years ago).

11. Do you have a partner living with you? ☐ Yes ☐ No

12. Is your partner the biological father of your toddler? ☐ Yes ☐ No

13. How long has your partner been living in the house with you? ___ Years ___ Months

14. Is your toddler a twin or multiple? ☐ Yes ☐ No

15. What is your toddler's date of birth?
___/___/20___

16. What is your toddler's gender? ☐ Male ☐ Female

17. What is your toddler's current weight? ___.__ pounds

18. Please read the following statements and put an "x" in the box most appropriate to your child's eating behavior.

	Never	Rarely	Sometimes	Often	Alwa
a. My child loves food	☐	☐	☐	☐	☐
b. My child eats more when worried	☐	☐	☐	☐	☐
c. My child has a big appetite	☐	☐	☐	☐	☐
d. My child finishes his/her meal quickly	☐	☐	☐	☐	☐
e. My child is interested in food	☐	☐	☐	☐	☐
f. My child is always asking for a drink	☐	☐	☐	☐	☐
g. My child refuses new foods at first	☐	☐	☐	☐	☐
h. My child eats slowly	☐	☐	☐	☐	☐
i. My child eats less when angry	☐	☐	☐	☐	☐
j. My child enjoys tasting new foods	☐	☐	☐	☐	☐
k. My child eats less when s/he is tired	☐	☐	☐	☐	☐

	Never	Rarely	Sometimes	Often	Alwa
l. My child is always asking for food	☐	☐	☐	☐	☐
m. My child eats more when annoyed	☐	☐	☐	☐	☐
n. If allowed to, my child would eat too much	☐	☐	☐	☐	☐
o. My child eats more when anxious	☐	☐	☐	☐	☐
p. My child enjoys a wide variety of foods	☐	☐	☐	☐	☐
q. My child leaves food on his/her plate at the end of a meal	☐	☐	☐	☐	☐
r. My child takes more than 30 minutes to finish a meal	☐	☐	☐	☐	☐
s. Given the choice, my child would eat most of the time	☐	☐	☐	☐	☐
t. My child looks forward to mealtimes	☐	☐	☐	☐	☐
u. My child gets full before his/her meal is finished	☐	☐	☐	☐	☐
v. My child enjoys eating	☐	☐	☐	☐	☐
w. My child eats more when s/he is happy	☐	☐	☐	☐	☐
x. My child is difficult to please with meals	☐	☐	☐	☐	☐
y. My child eats less when upset	☐	☐	☐	☐	☐
z. My child gets full up easily	☐	☐	☐	☐	☐
aa. My child eats more when s/he has nothing else to do	☐	☐	☐	☐	☐
bb. Even if my child is full, s/he finds room to eat his/her favorite food	☐	☐	☐	☐	☐
cc. If given the chance, my child would drink continuously throughout the day	☐	☐	☐	☐	☐
dd. My child cannot eat a meal if s/he has had a snack just before	☐	☐	☐	☐	☐
ee. If given the chance, my child would always be having a drink	☐	☐	☐	☐	☐
ff. My child is interested in tasting food s/he hasn't tasted before	☐	☐	☐	☐	☐
gg. My child decides that s/he doesn't like a food, even without tasting it	☐	☐	☐	☐	☐
hh. If given the chance, my child would always have food in his/her mouth	☐	☐	☐	☐	☐
ii. My child eats more and more slowly during the course of a meal	☐	☐	☐	☐	☐

19. Please read the following statements and put an "x" in the appropriate box to show how you deal with feeding your child. It is important to remember that there are no right or wrong answers to these questions; we are interested in what parents really feel and do.

		Never	Rarely	Sometimes	Often	Alw
a.	I allow my child to choose which foods to have for meals	☐	☐	☐	☐	☐
b.	I give my child something to eat to make him/her feel better when s/he is feeling upset	☐	☐	☐	☐	☐
c.	I encourage my child to look forward to the meal	☐	☐	☐	☐	☐
d.	I praise my child if s/he eats what I give him/her	☐	☐	☐	☐	☐
e.	I decide how many snacks my child should have	☐	☐	☐	☐	☐
f.	I encourage my child to eat a wide variety of foods	☐	☐	☐	☐	☐
g.	In order to get my child to behave him/herself I promise him/her something to eat	☐	☐	☐	☐	☐
h.	I present food in an attractive way to my child	☐	☐	☐	☐	☐
i.	If my child misbehaves I withhold his/her favorite food	☐	☐	☐	☐	☐
j.	I encourage my child to taste each of the foods I serve at mealtimes	☐	☐	☐	☐	☐
k.	I allow my child to wander around during a meal	☐	☐	☐	☐	☐
l.	I encourage my child to try foods that s/he hasn't tasted before	☐	☐	☐	☐	☐
m.	I give my child something to eat to make him/her feel better when s/he has been hurt	☐	☐	☐	☐	☐
n.	I let my child decide when s/he would like to have her meal	☐	☐	☐	☐	☐
o.	I give my child something to eat if s/he is feeling bored	☐	☐	☐	☐	☐
p.	I allow my child to decide when s/he has had enough snacks to eat	☐	☐	☐	☐	☐
q.	I decide when it is time for my child to have a snack	☐	☐	☐	☐	☐
r.	I use desserts as a bribe to get my child to eat his/her main course	☐	☐	☐	☐	☐
s.	I encourage my child to enjoy his/her food	☐	☐	☐	☐	☐
t.	I decide the times when my child eats his/her meals	☐	☐	☐	☐	☐
u.	I give my child something to eat to make him/her feel better when s/he is worried	☐	☐	☐	☐	☐
v.	I reward my child with something to eat when s/he is well behaved	☐	☐	☐	☐	☐
w.	I let my child eat between meals whenever s/he wants	☐	☐	☐	☐	☐
x.	I insist my child eats meals at the table	☐	☐	☐	☐	☐
y.	I give my child something to eat to make him/her feel better when s/he is feeling angry	☐	☐	☐	☐	☐

	Never	Rarely	Sometimes	Often	Alw
z. I decide what my child eats between meals	☐	☐	☐	☐	☐
aa. I praise my child if s/he eats a new food	☐	☐	☐	☐	☐

20. Now we'd like to ask you some questions about your general home environment.

	Never	Rarely	Sometimes	Often	Alwa
a. How often do you have healthy snacks in the home? (e.g., raisins, pretzels or Cheerios)	☐	☐	☐	☐	☐
b. How often do you have vegetables in the home? (e.g. fresh, frozen, or canned)	☐	☐	☐	☐	☐
c. How often do you have fruit in the home? (e.g. fresh, frozen, or canned)	☐	☐	☐	☐	☐
d. How often do you have soda or sugary beverages in the home? (e.g. Coke, Pepsi, Hi-C, and Sunny D; do not include 100% fruit juices or "diet" drinks)	☐	☐	☐	☐	☐
e. Are there toys that encourage physical activity in or around the home? (e.g. balls, tricycle, etc.)	☐	☐	☐	☐	☐

21. Do you have a place inside your home where kids can roll, climb, jump and dance?

☐ Yes ☐ No

22. Do you have a place outside where kids can roll, climb, and jump (e.g., playground)?

☐ Yes ☐ No

23. On a **typical day**, how often is the TV on in your home (even when no one is watching)?

☐ 1 hour or less
☐ 2 hours
☐ 3 hours
☐ 4 hours
☐ 5 hours
☐ 6 hours or more
☐ None
☐ Don't know

24. How many hours of television/video does your toddler actually watch on a **typical week day**?

☐ 1 hour or less
☐ 2 hours
☐ 5 hours
☐ 6 hours or more

☐ 3 hours
☐ 4 hours
☐ None
☐ Don't know

25. How many hours of television/video does your toddler actually watch on a **typical weekend day**?

☐ 1 hour or less
☐ 2 hours
☐ 3 hours
☐ 4 hours
☐ 5 hours
☐ 6 hours or more
☐ None
☐ Don't know

26. How many hours of outdoor play time does your toddler experience on a **typical week day**?

☐ 1 hour or less
☐ 2 hours
☐ 3 hours
☐ 4 hours
☐ 5 hours
☐ 6 hours or more
☐ None
☐ Don't know

27. How many hours of outdoor play time does your toddler experience on a **typical weekend day**?

☐ 1 hour or less
☐ 2 hours
☐ 3 hours
☐ 4 hours
☐ 5 hours
☐ 6 hours or more
☐ None
☐ Don't know

Again, thank you for taking the time to complete this survey. Please return it to the interviewer. If you have taken the survey home, please mail it back to us in the self-addressed stamped envelope provided. You will receive $15 as a thank-you for answering the questions and agreeing to have your child weighed.