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The Influence of Birth Weight on Body Mass Index in Young Children in Northwest Arkansas

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Abstract

Body Mass Index (BMI) is a screening tool to measure body fat that is calculated based on the height, weight, age, and gender of a child. Being overweight as a child is defined as having a BMI between the 85th and 95th percentiles. Obesity is defined as having a BMI at or above the 95th percentile ("Basics About Childhood Obesity," 2012). Having a high BMI comes with an increased risk of multiple co-morbidities, both physical and psychosocial (Pulgarón, 2013). Birth weight has been presumed to play a role in the prevalence of obesity in children. The purpose of this study was to determine the correlation of birth weight and obesity. A retrospective chart review from patients Harvey Pediatric evaluated weight at birth, two years, four years, and seven years of age to determine if there was a correlation between BMI and birth weight in NWA. 53 chart reviews were completed, and although there were small positive correlations between birth weight and body mass index at ages two and four, there was no statistically significant correlation. Therefore the hypothesis, there is no statistically significant difference between birth weight and BMI measurements in children at the ages of birth, 2, 5, and 7 years, was accepted.

Background and Significance

Childhood obesity is a topic that is constantly being covered by the news in America. Childhood weight gain is becoming a more prominent health disparity for minority children each year. According to the Centers for Disease Control and Prevention (CDC), being overweight as a child is defined as a body mass index (BMI) that is between the 85th and 95th percentiles. Obesity is defined as having a body mass at or above the 95th percentile. As children progress through development and puberty, the normal percentage of body fat fluctuates. To accommodate these fluctuations, the CDC has developed growth charts that incorporate the way male and female's bodies differ between the ages of two to18 ("Basics About Childhood Obesity," 2012).

Obesity is associated with numerous co-morbidities. While most health related issues appear to be physical such as orthopedic problems, hypertension, type-II diabetes, hyperlipidemia, and types of heart disease, as well as gallbladder cancer ("Increased BMI ups cancer risk", 2014), disk degeneration, acanthosis nigrans, and differences in timing of sexual maturation (Pulgarón, 2013), many co-morbidities fly under the radar as psychosocial problems. Obese children are associated with a higher incidence of ADHD, greater internalizing and externalizing symptoms, sleep problems, as well as depression and poor self esteem (Pulgarón, 2013). Because of the extent that obesity affects children in all aspects of their lives, it has become a major focus of the Healthy People 2020 Objectives (Nutrition and Weight Status, n.d.).

Birth weight and maternal pre-pregnancy BMI are factors that have been presumed to largely influence a child's BMI. Overall, children who are born small for gestational age (SGA) or from mothers who have elevated pre-pregnancy BMIs have a higher prevalence of being overweight at age five than do children who are large for gestational age (LGA) or from mothers with a low or normal pre-pregnancy BMI (Laitinen et al., 2012). While looking at the association of birth weight to childhood obesity, the factors that play into birth weight must also be considered. Maternal BMI prior to pregnancy and gestational weight gain (GWG) are being linked as major determinants towards a child's birth weight. Maternal pre-pregnancy BMI and weight gain in the first and third trimesters have been shown to impact the birth weight of the infant (Estampador et al., 2014). Gestational weight gain during the first half of the pregnancy has been found to have a positive correlation with the BMI of the child (Laitinen et al., 2012). However, there is no evidence to support that maternal weight gain during the middle trimester affects birth weight (Margerison-Zilko et al., 2012). Studies demonstrate that women who experience more GWG but have a lower pre-pregnancy BMI are more likely to have a SGA baby because of the low pre-pregnancy BMI. Women who have a high pre-pregnancy BMI but lower GWG are at an increased chance of having a LGA baby. Women experiencing increased GWG throughout all the trimesters are correlated with an increased odds ratio of producing LGA offspring and a decreased odds ratio for SGA offspring (Hunt, Alanis, Johnson, Mayorga & Korte, 2013).

Research examining the impact of birth weight trends on BMI in childhood is sparse. However, information regarding the rate of weight gain in infancy and its

effect on BMI is more available. One reason that SGA babies may be at a higher risk for being overweight at age five is because of the increase rate of weight gain during the first year of life. A study of more than 200,000 individuals people found that the lower the birth rate the higher risk for coronary heart disease later in life. Researchers also found via observation of adults over a period of eight years, those born SGA had a higher BMI than those born appropriate for gestational age. At birth, SGA babies have a decreased presence of fat mass around the abdomen when compared with infants born with appropriate gestational weight (Andersen et al., 2010). This is explained by the rate at which infants gain weight in their first year of life. A 2011 study focused on the effect of weight gain during the first six months of life, and was found to have clinical and statistical significance for obesity at age five, than if the weight was gained in a different six-month period during the first two years of life. If the child gained more than half of their weight for age during months two to four, the chance of the child being overweight at age two years was much greater than if the child gained more than half of their weight for age during months zero to two or four to six.. (Young, Johnson, and Krebs, 2012). There is limited literature comparing birth weight to subsequent weight gain in infants and children.

Purpose of the Study and Research Questions

The purpose of this study was to determine the effect of birth weight on childhood BMI from birth to seven years of age in a population of children in Northwest Arkansas.

Hypothesis

Based on the review of literature, this was the hypothesis: 1) there is no statistically significant difference between birth weight and BMI measurements in children at the ages of birth, two, five, and seven years.

Methodology

This study was performed upon approval of the University of Arkansas Institutional Review Board (IRB). The study design was a retrospective chart review using secondary data provided from Harvey Pediatrics, a clinic in NW Arkansas (NWA(that provides care to patients not only in NWA, but also in SE Missouri and NE Oklahoma. The sample consisted of medical records of patients that have documented birth weight, weight at two years, weight at five years, and weight at seven years. All patient information was de-identified as per the Health Portability and Accountability Act (HIPAA). Each medical record case was assigned a randomized case number. Once the review was completed, the medical record was unable to be matched to the study case number. Demographic data and data related to the study variables were obtained and recorded for evaluation in the study. Information was classified based off of three different categories: small for gestational age (SGA) which is less than 2500 grams, appropriate for gestational age (AGA), and large for gestational age (LGA) which is weight above the 90th percentile ("Clinical Growth Charts," 2009").

Statistical Analysis

This study utilized a paired t-test and Pearson's Product-Moment Correlation Coefficient to see if there is a correlation between birth weight and BMI.

Results

Chart reviews on 53 children at ages birth, two, four, and five were completed comparing the birth weight with the child's body mass index at ages two, four, and five. As shown in table 1, there was a small positive correlation between the birth weight and the body mass index at age two, *r*= .210, as well as between birth weight and the body mass index at age four, *r*= .199. The correlation between birth weight and BMI at age two was stronger than the correlation between birth weight and BMI at age four. There was a small negative correlation between birth weight and the child's BMI at age five, *r*= -.141.

Table 1

Correlations

		BIRTHWEIGHT	BMI 2 YRS PERCENTAGE	BMI 4YRS PERCENTAGE	BMI 5YRS PERCENTAGE
BIRTHWEIGHT	Pearson Correlation	1	.210	.199	-.141
	Sig. (2-tailed)		.131	.152	.316
	N	53	53	53	53
BMI 2 YRS PERCENTAGE	Pearson Correlation	.210	1	.114	-.120
	Sig. (2-tailed)	.131		.416	.393
	N	53	53	53	53
BMI 4YRS PERCENTAGE	Pearson Correlation	.199	.114	1	.218
	Sig. (2-tailed)	.152	.416		.118
	N	53	53	53	53
BMI 5YRS PERCENTAGE	Pearson Correlation	-.141	-.120	.218	1
	Sig. (2-tailed)	.316	.393	.118	
	N	53	53	53	53

Discussion

Obesity has become an epidemic in the United States of America, and is now one of the Healthy People 2020 objectives. Children who are obese have an increased likelihood of being affected by the physical and psychosocial co-

morbidities of obesity. Multiple factors, including maternal pre-pregnancy BMI and gestational weight gain, affect the birth weight of the infant. The literature has supported a correlation between birth weight and BMI of the child at ages two, five, and seven.

For some young children in Northwest Arkansas, birth weight does not appear to play a statistically significant factor into the child's BMI. As stated above, multiple factors affect the BMI of children, such as the maternal pre-pregnancy BMI, the amount of weight gained by the mother during each trimester of pregnancy, and the rate the child gained weight during the first year of life. Further research into these factors would be helpful in determining more specific causes of pediatric obesity in Northwest Arkansas.

The literature supports a correlation between birth weight and childhood BMI at ages two, five, and seven. There were slight positive correlations between birth weight and BMI at age two, and birth weight and BMI at age four, and there was a slight negative correlation between birth weight and BMI at age five. Perhaps if the study were conducted with a larger sample size with a more complete data set the results would yield stronger correlations.

The study had multiple limitations. First, the amount of missing data for the children at ages birth, two, five, and seven caused adaptations to be made to the analysis of the data. The data was analyzed using the birth weight and BMI of the child at ages two, four, and five rather than two, five, and seven due to the lack of data at ages two, five, and seven. Also, the sample size of the data was only 53 children. Also, the analysis did not factor in the socioeconomic status, ethnicity, or

gender of the children. All of these factors could play a part into the BMI of the child at ages two, five, and seven. Future studies should be conducted over a much larger sample with complete data sets, perhaps the results would turn out differently. The literature supports a correlation between small for gestational age infants and high childhood BMI. A study looking into these factors should be conducted. Another angle of future studies that should be included is following the mother of the child from the most recent BMI before conception through the end of the pregnancy. Monitoring the maternal BMI and weight gain during pregnancy could factor into the BMI of the child at a later date. Following the child monthly during their first year of life, and then yearly after that, could show the rate at which the child was gaining weight during his or her first year of life and how that might affect the BMI of the child at ages two, five, and seven.

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