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Mothers' Health and Health Behaviors that Influence Childhood Obesity

Maternal BMI & Infant Feeding Methods

By

Mohamed Abdullah Alammari

A Thesis Submitted in Partial Fulfillment of the Requirements for

Masters of Science

In

Department of Health Sciences

(Community Health)

Minnesota State University, Mankato

Mankato, Minnesota

July 2012

Mothers' Health Behaviors that Influence Childhood Obesity

Maternal BMI & Infant Feeding Methods

Mohamed Abdullah Alammari

This thesis has been examined and approved by the following members of the thesis committee.

Dr. Marge Murray-Davis, Chairperson

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Abstract

The rate of childhood obesity in America continues to climb. Many medical experts believe that childhood obesity can develop as early as prenatal development in the uterus, and infancy. The purpose of this study is to explore the relationships between mothers' health and health behaviors (maternal BMI and infant feeding methods) and childhood obesity. We conducted and analyzed a sample of 307 mothers and their children (307) to examine each mother's maternal BMI and her child or children's BMI. We also examined mothers' feeding methods (bottle vs. breastfeeding). The result of this research did not match with the review of literature. Due to small sample size and limited age of children (0-6 months) in the sample, results were not significant. This study will be an important educational tool for health professions to encourage mothers in regard to maintain maternal healthy weight and promoting breast-feeding.

Table of Contents

Chapter one Introduction.....	1
Statement of the Problem.....	2
Significance of the Problem.....	3
Hypothesis.....	4
Research Questions.....	4
Delimitations.....	5
Limitations.....	5
Assumptions.....	6
Definitions.....	6
Chapter Two: Review of Literature.....	8
Introduction.....	8
The Current Health Issue of Childhood Obesity.....	8
Factors that influence Childhood Obesity.....	11
Maternal Weight (BMI).....	11
Birth Weight (BMI).....	13
Gestational Diabetes.....	15

Infant's Diet.....	16
Other Factors Influenced Childhood Obesity.....	17
Genetic Factors.....	17
Human's Genes.....	18
Summary.....	18
Chapter Three: Methodology.....	20
Introduction.....	20
Description of Research Design.....	20
Instrumentation.....	21
Data Collection.....	21
Data Analysis.....	22
Summary.....	22
Chapter Four: Results and Discussion.....	23
Participants.....	23
Results.....	24
Discussion.....	25
Chapter Five: Conclusion & Recommendation.....	27

Introduction.....	27
Conclusions.....	28
Recommendations for Health Educators.....	29
Recommendations for Future Research.....	30
Childhood Obesity Intervention.....	30
Maternal Weight.....	30
Infant’s Diet.....	31
Early Childhood Diet.....	31
Eating Behaviors.....	33
References.....	35
Appendix A.....	44
Appendix B.....	46
Appendix C.....	47
Appendix D.....	48
Appendix E.....	49

Chapter One: Introduction

The World Health Organization (WHO) in 2010 estimated that there are more than 42 million overweight children worldwide (WHO, 2011). In the United States childhood obesity is on the rise, and children in the United States are victim to the obesity epidemic. It has been predicted that the United States life expectancy will decline for the first time in recent history because of the rising incidence of childhood obesity (Gittelsohn & Kumar, 2007). Childhood obesity is a serious health condition as it predisposes young children to an increased risk of developing both chronic diseases and disabilities; there are many health consequences of childhood obesity include increased the risk of heart diseases, cancer, and type 1 and type 2 diabetes (Centers for Disease Control and Prevention [CDC], 2009 a).

Kiess et al. (2001) identified that obesity is the degree of body fat mass; Body Mass Index (BMI) depends upon ethnic background (genes), gender (average weight girls should have more body fat than boys), developmental stage, and age (Kiess, et al.). The most accurate clinical measurements for obesity are skin- fold thickness and body mass index (BMI) (Kiess et al.). A child with a BMI above 97 % would be considered overweight (Davison & Birch, 2001). This number should be correlated to age and gender. Today 25 % of the children in the United States between the ages of 6 and 17 years old are reportedly overweight (Davison & Birch). Between the 1980's and the 1990's, childhood obesity in the United States had more than doubled. According to

CDC, (2011) the percentage of childhood obesity in the 1980's jumped from 7 percent to 17 percent (12.5 million) in 2010 (CDC).

During the stages of life, exposures that contribute to the development of obesity may be attributable to environmental, social, behavioral, or biological (including genetic) factors. This is similar to the life course approach to chronic disease that focuses on the fact that such exposures may occur at different stages of life, from uterus, during fetal development, infancy, childhood, adolescence, and beyond (Gillman, 2004). There are many factors that determine obesity, starting from uterus through childhood (including infant nursing methods) and adolescence. For example, high maternal body mass index (BMI) may develop high pregnancy glucose and insulin levels in both mother and fetus. This high level of pregnancy glucose might increase newborn weight and BMI. Also, during the postnatal period what the newborn, infant, and child eats can determine the rate of growth and influence the timing and magnitude of obesity in childhood (Gillman). Furthermore, child activity and feeding methods contribute to child weight and BMI being overweight, and obese. Those factors would result in morbid outcomes, such as insulin resistance, heart disease, and type 2 diabetes mellitus (Gillman).

Statement of the Problem

In recent years, the rate of childhood overweight have increased very rapidly, not only in the United States but also worldwide, that the problem has been called an epidemic (N.M. Philipsen & N.C. Philipsen, 2008). Obesity prevention can start as early

as conception (Philipsen & Philipes). Maternal obesity is a major risk factor for childhood obesity (Drake & Reynolds, 2010). Schack-Nielsen et al. (2010) suggested a positive correlation between gestational weight gain and child's BMI at all ages. Another factor to child's weigh is postnatal; breast fed or bottle fed has an important impact on a child's weight (Hediger et al., 2001). Breastfed children have lower risk of being overweight than not-breastfed children (Philipsen & Philipsen). The early postnatal health behavior (e.g. breastfeeding) appears able to influence later obesity (Gillman, 2004). The purpose of this thesis is to identify mothers' health and health behaviors that could contribute to childhood obesity. Some of these health issues and health behaviors are maternal BMI, and infant nursing methods. The study is measuring mothers' and infants' BMI to determine whether a person is overweight or obese.

Significance of the Problem

It is not just the raising rate of childhood obesity that makes the problem so troubling, but the negative results associated with being an overweight child. An overweight child can experience adverse effects, both physically and psychologically; furthermore, being overweight in childhood predicts being overweight in adulthood, and being an overweight or obese adult comes with a whole set of negative outcomes (Philipsen & Philipsen, 2008); such as heart diseases, cancer, and type 1 and type 2 diabetes (CDC, 2009 a).

According to the CDC (2009 b) 18% of the U.S. adolescents aged 12 to 19 years were overweight between the year 2005-2006. In the same year there were 26% of children aged 2 to 11 years were overweight (CDC, 2009 b).

The problem addressed in this research is to identify mothers' health and health behaviors that could contribute to childhood obesity. Some of these health issue and health behaviors are maternal BMI, and infant nursing methods. Understanding the relationship between mothers' health and childhood obesity would give health professions new educational tools to prevent childhood obesity and obesity in general as early as conception.

Hypothesis

Due to the rising rate of childhood obesity in the United States, this research was determined to examine if obesity starts before birth.

- There is no relationship between mothers' health and health behaviors (maternal BMI and infant feeding methods) and their children's BMI.

Research Questions

1. What is the relationship between mother's maternal BMI & infant's birth BMI?
2. What is the relationship between mothers' maternal BMI and infants (0-6 months) BMI?

3. Is there a difference in infant (0-6 months) BMI when breast fed versus bottle fed?

Delimitations

The review of literature includes a perception of current research as it relates to some factors contributing to childhood obesity in the United States. The boundaries were set up for this study included a specific time frame. Data was collected over a time period of three months, started April, 2012. The data was collected from Mayo Clinic Health System in Mankato, Minnesota. The target populations were mothers and their infants (new born up to 6 months old; who have regular doctor visits).

Limitations

The limitations of this study include:

- small sample sizes
- limited time for data collection.
- limited inadequate published research and study reports explain the relationships between mothers' health behaviors and childhood obesity
- the study was conducted in six months, January to July 2012
- the researcher was not part of the data collection team

Assumptions

It is assumed that the information that is taken from the participants' medical records/electronic files is correct. It is important to assume that these data were documented accurately in the participants' medical records/electronic files.

Definitions**Overweight:**

Overweight is defined as abnormal or excessive fat accumulation that may impair health (World Health Organization, 2012).

Obesity:

The presence of excessive body fat or adipose tissue in relation to lean body mass. The distribution and amount of body fat and the extent of ADIPOSITY are both clinically relevant, but precise measurement can be difficult. Measures of weight relative to height and a BODY MASS INDEX (BMI) above 30 are used to define clinical obesity, but some athletes with a lean body mass have a BMI above 30. (Last, 2007, p. 261).

Body Mass Index (BMI):

The body weight in kilograms divided by the square of the height in meters. This anthropometric measure is an indicator of fatness and obesity.

It correlates closely with skinfold thickness and density of the body. The desirable range is 20 to 25. Above 25 is overweight, and above 30 is obesity. BMI below the lower end of the acceptable range indicates undernutrition. The BMI has been regarded as a reliable predictor of susceptibility to coronary heart disease, but the ratio of waist-to-hip circumference may be a better predictor (Last, 2007, p. 42).

Birth Weight:

The weight of an infant at birth, an important indicator of health status.

The birth weight of a normal full-term infant is usually in the range 3,000 to 4,000 grams. Low birth weight, usually caused by prematurity, or various diseases, is birth weight below 2,500 grams (Last, 2007, p. 39).

Childhood obesity:

Childhood obesity is a serious medical condition that affects children and adolescents. It occurs when a child is well above the normal weight for his or her age and height (Mayo Clinic, 2012).

Chapter Two: Review of Literature

Introduction

The purpose of this study is to explore the relationships between mother's health and health behaviors (maternal BMI and infant feeding methods) that may contribute to childhood obesity. Overviews of the current health issue of childhood obesity and recent statistics about obesity are crucial to understand the possible impact of the current epidemic of childhood obesity in the United States. Relevant literature was reviewed to determine the (a) the severity of the epidemic of childhood obesity, (b) the impact of maternal weight and BMI to childhood obesity, (c) the impact of high birth weight and BMI to childhood obesity, (d) the influenced of infant feeding methods to childhood obesity, (e) the contribution of gestational diabetes to childhood obesity, (f) the genetic factor that could influenced childhood obesity and (g) some of the intervention that could reduce the rate of childhood obesity in the United States.

The Current Health Issue of Childhood Obesity

Childhood obesity is a serious health problem in the United States and around the world (WHO, 2011). Ten percent of the United States' children younger than two years old are overweight. Also 21 % of the United States' children between two and five years old are overweight (Ogden, Carroll, Curtin, Lamb, & Flegal, 2010). Childhood overweight and obesity has significant lifelong negative effects on the health and well being of children such as type 2diabetes (Daniels, 2006). According to Centers for

Disease Control and Prevention (CDC) (2009 b), approximately one in three adults in the United States is obese; and one in six children age 6-11 years in the United States is obese (CDC, 2009 b).

In a study by Moss and Yeaton (2009) examining BMI of 8,900 9-month-old babies and 7,500 2-years-old toddlers, found 32% of children were either obese or at risk of obesity by the tender age of nine months; that figure increased to 34% by the time the children reached their second birthdays (Moss & Yeaton). The study found that boys were more at risk of being obese or overweight than girls, Latinos had the highest risk of being obese or overweight, and the family's socioeconomic status didn't seem to make a difference at 9 months of age; but by two years, children in the bottom economic 20% were most likely to be obese or at risk, while those in the top 20% were least likely to be obese or at risk (Moss & Yeaton).

Obesity is one of the causes of death that attributable to heart disease, cancer, and diabetes (CDC, 2011). Heart disease is the leading cause of death in the United States, in both men and women; in 2008 more than 616,000 people in the United States died of heart disease, the cause of death for one in four Americans (Miniño, Murphy, Xu, & Kochanek, 2011). Cancer is the second leading death in the United States; in 2009, over 567,000 people in the United States died of cancer (Miniño et al.). Thus, preventing obesity can significantly cut health care spending in the United States. According to Finkelstein, Trogon, Cohen, & Dietz (2009), the health care costs of obesity in the

United States are staggering; in 2008, these costs were about \$147 billion (Finkelstein et al.).

Mothers' health and health behaviors such as maternal BMI and infant nursing methods are relevant aspects of the circumstances of what related to childhood obesity (Hediger, Overpeck, Kuczmarski, & Ruan, 2001). Another mother's health behavior factor that may contribute to childhood obesity is gestational diabetes, which occurs in 3% of all pregnancies in the United States. Resultant neonatal and pediatric sequelae (secondary consequence) of childhood obesity, metabolic syndrome and type 2-diabetes are clearly an important pediatric health care issue (Vohr, & Bony, 2008).

In some cases parents' genes can play a role in the development of obesity, in how the body regulates, capture, store, and release energy from food (CDC, 2010 a). Burniat, Cole, Lissau, and Poskitt (2002) argued that the development of obesity in the vast majority of cases is a multifactorial event with a genetic predisposition affected by environmental factors (Burniat et al.). Studying the human genes, researchers found only six monogenetic that can cause obesity, all are very rare conditions of endocrine disorders (Burniat et al.). The significance of the genetic factor that influenced obesity is estimated to be between 5% and 25%, however the increasing prevalence of obesity during the past two decades appears to owe mostly to environmental factors such as home milieu and parental influence (McGarvey, Keller, Forrester, Williams, & Seward, 2004).

The United States society has been characterized by environments that promote physical inactive lifestyle (such as, lack of sidewalk in some communities) and increased consumption of unhealthy diet (such as, lack of fresh food in some communities) (CDC, 2010 b). The high rate of obesity may be attributed to not just heredity, but also to society and environment influenced upon physical activity and eating habits (McGarvey et al., 2004).

Factors that Influence of Childhood Obesity

Maternal weight (BMI). A growing body of research is examining the role of maternal environment on later health outcomes for children, especially when it comes to the propensity to overweight and obesity. Maternal pregnancy weight can have a significant factor on the child's weight (Hediger et al., 2001). Hediger et al. reported that the strongest predictor of child BMI status was mother's concurrent BMI. Children were at steady increased risk for being at risk of overweight with an overweight mother (AOR [Adjusted Odds Ratio] , 1.54; 95% CI, 0.93-2.57) but almost three times more likely to be at risk of overweight child with maternal obesity (AOR, 2.97; 95% CI, 1.88-4.69). Furthermore, the risk of being an overweight child was nearly 3-fold greater (AOR, 2.95; 95% CI, 1.35-6.42) with maternal overweight and more than 4-fold greater (AOR, 4.34; 95% CI, 2.50-7.54) with maternal obesity (Hediger et al.).

A study by Schack-Nielsen, Michaelsen, Gamborg, Mortensen, and Soresen (2010) suggested an association between gestational weight gain and offspring BMI at all

ages. The retrospective study examined more than 4,000 participants from birth to adulthood (around 42 years), the result indicated that gestational weight gain was associated with offspring BMI at all ages; greater gestational weight gain was associated with an increased BMI in childhood through adulthood (Schack-Nielsen et al.).

The World Health Organization did a study by Ota, Haruna, Suzuki, Anh, Tho and Yanai (2010) in Viet Nam examining the relationship between maternal BMI, gestational weight and maternal outcomes. The study included 2,989 mothers and their 2,989 infants (53.3% male & 46.7% female), mothers with low maternal BMI had 18.1% low birth weight (below the 10th percentile) infants; on the other hand, mothers with high maternal BMI had 21.2% high birth weight (above the 90th percental) infants (Ota et al.).

A retrospective study of 10,000 children found that the risk of being overweight by age seven was 48% higher for children whose mothers had excessive pregnancy weight gain, even after accounting for numerous potential confounders (Wrotniak, 2008). A recent study by Josefson (2011) found that women who gained excessive maternal weight had newborns with more fat mass than newborns whose mothers gained the appropriate amount-13.9 ounces of fat compared with 17.5 ounces (Josefson).

It appears that there is something about pregnant mothers gaining more than the Institute of Medicine recommendation that may predispose their children extra pound (Muth, 2012). Researchers suggest several potential explanations for the relationship between excess maternal weight gain and childhood obesity; for example mothers who

gain maternal weight have high blood sugar. Even if they did not develop gestational diabetes, glucose does pass through the placenta but insulin does not. When the fetus experiences the elevated blood sugar, the fetus pancreas must secrete more insulin to normalize blood sugar levels. The problem is that insulin itself is a growth factor causing the fetus to be larger; and that might initiate a hormonal cascade that leads to increased appetite and weight gain in children, adolescence, and adult (Muth).

Birth weight (BMI). Birth weight is one of the factors that might influence childhood obesity (Gillman, 2004). Bavdekar, Yajnik, Fall, Bapat, and Pandit (1999) reported a study showing a positive relationship between a child's high birth weight and high BMI level over a broad age range; for example the study showing a positive correlation between child birth weight and child BMI, in 250-g groupings between 2 kg (4.4 lbs.) and >3.25 kg (7.2 lbs.) examine children's BMI at 8 years of age; the mean BMI increased linearly from 13 to 14.1 across the birth weight of the newborn infants (Bavdekar et al.).

Another study by Gillman, Rifas-Shiman, Berkey, Field, and Colditz (2003) of more than 14,000 children 9 to 14 years of age, showed high birth weight increased risk of adolescents being overweight between 30% to 50% with a 1-kg (2.20 lbs.) increase in birth weight (3-5% increase in the odds ratio [OR] per 100-g increase in birth weight) (Gillman et al.).

A retrospective study by Johannsson, Arngrimsson, Thorsdottir, and Sveinsson (2006) examined the effect of high birth weight children by tracking children's weight from birth to adolescence; the study investigated the weight of 1328 children aged 9 and 15-year-old from 18 randomly selected schools in Iceland. The data included children's weight starting from birth, and ages 2 1/2, 6, 9, and 12 years. One of the findings of the study showed that children who weighed above the 85th percentile at birth were more likely than other children to be overweight at the age of 6 years (OR=1.8), 9 years ([odds ratio] OR=2.1), and 15 years ([odds ratio] OR=2.0) (Johannsson et al.).

Another study in Brazil by González, Nazmi, and Victora (2010) evaluated the effects of birth weight and weight gain from birth to age 23 years on waist circumference, hip circumference, and waist-to-hip ratio. The study approved that high birth weight had positive association with waist circumference, and hip circumference; also the study showed that weight gain during pregnancy and the first two years of a child's life had long-term effects on hip circumference (González et al.).

Also, low birth weight might influence childhood obesity. Gaskins et al. (2010) examined BMI of 312 preterm children at age of 11-year old; overall, 24% were obese (BMI for age \geq 95th percentile) and 16.7% were overweight (BMI \geq 85th and $<$ 95th percentiles) (Gaskins et al., 2010). In adjusted analyses Gaskins et al. found a positive association between small gestational age (birth weight below the 10th percentile) and overweight children (odds ratio [OR] = 3.4, confidence interval [CI] 1.5 to 7.5); and a

positive association between high birth weight and obese children (OR = 1.8, CI 1.1 to 2.4) and overweigh children (OR = 1.4, CI 1.1 to 2.0) (Gaskins et al.).

Gestational diabetes. Diabetes during pregnancy is a strong risk factor for obesity in the offspring (Pettitt, et al., 2010). Vohr, McGarvey and Coll (1995) explain that obese mothers with gestational diabetes mellitus have an increased risk (37%) of delivering infants with macrosomia (abnormal large fetus) versus non-obese gestational diabetes mothers (14%); untreated gestational diabetes during pregnancy is a factor which contributes to macrosomia in the neonate (Vohr et al.). The consequences of maternal hyperglycemia in the gestational diabetes pregnancy producing macrosomia has been studied to include all the nutrients (glucose, amino acids and lipids) which cross into the placenta (Vohr, & Bony, 2008). Neonatal macrosomia has well known neonatal morbidities; and many have potential long term consequences including obesity, hypertension, hyperglycemia, dyslipidemia, and related behavioral problems (Vohr, & Bony).

In small town in the state of Indiana, Pettitt, Knowler, Bennett, Aleck, and Baird (1987) evaluated the presence of obesity at age 5 to 19 children whose mothers had gestational diabetes. The researchers found that childhood obesity in the older child was directly related to maternal diabetes, which supports the hypothesis of the significant role of intra uterine environment as well as genetic factors (Pettitt et al., 1987). Another study

by Pettitt et al. found little association between gestational diabetes and obese children at age 2-years (Pettitt et al.).

Infant's diet. Breast-feeding or bottle-feeding has an important impact on a child's weight and health. As Hediger and associates (2001) reported that there was a significant reduction of risk for being overweight with children who were breastfed in some point in their childhood (AOR, 0.63; 95% CI, 0.41-0.96), even adjusting for birth weight status, race/ethnicity, sex, age group, mother's BMI status, and the timing of introduction of solid foods. However, there was no clear dose-dependent effect of duration of full breastfeeding nor was there a recognizable threshold effect of breastfeeding. The AOR for being at risk of being overweight with full breastfeeding for 3 months or more was 0.67 (95% CI, 0.39-1.14), indistinguishable from the AOR of 0.66 (95% CI, 0.34-1.29) for being at risk of overweight with full breastfeeding for 6 months or more (Hediger et al.).

The early postnatal health behavior in regard to nutrition appears able to influence later obesity. There is much evidence indicating that breastfeeding plays a role in preventing later obesity. One possible mechanism is metabolic programming that forms through breast milk itself (Gillman, 2004). Lucas et al. (1980) suggested that breast milk and formula produces different insulin responses (Lucas et al.). Another study by Locke (2002) suggested that there is a difference in leptin concentrations between breastfed versus bottle-fed infants (Locke, 2002). Gillman argued that breastfeeding results to more

internal control of energy intake by the child on the other hand there might be more parental control over formula feeding (Gillman).

Many studies suggested a possible negative correlation effect of breastfeeding duration to obesity. Gillman et al. (2001) showed a decrease in the risk of being overweight in adolescence with increased duration of breastfeeding in infancy. Kries et al. (1999) showed consistent weight mean reduction in the prevalence of later obesity, in a combined set of studies, when breastfeeding was considered dichotomously (yes or no) (Kries et al.). Bergmann et al. (2003) studies children nine times between birth and six years of age to compare participants who were breastfed for more than three months or less than three months and participants who were bottle fed. In both BMI and triceps skin-fold measurements, breastfed participants began to show clearly different (low) BMI scores as compared to bottle-fed participants at three to four years of age.

Other factors influenced childhood obesity. There are many factors (e.g. genetics) that can play part of childhood obesity.

Genetic factors. The energy content of the human body is under the control of several regulatory systems (Rosenbaum & Leibel, 1998). Some scientific researches clearly demolished the once widespread idea that obesity is the cause of to a lack of willpower (Burniat et al., 2002). According to Burniat and associates, the development of obesity in the vast majority of cases, is a multifactorial event with a genetic predisposition affected by environmental factors.

In human genes, researchers found only six monogenetic genes that can cause obesity; all are very rare conditions of endocrine disorders (Burniat et al.). The first condition is called Congenital leptin deficiency (Montague et al., 1997). The second gene disorder is called Leptin Receptor Defect (Clement et al., 1998). The third gene defect that causes obesity is Prohormone Convertase 1 (PC 1) Defect (Jackson et al., 1997). The fourth disorder is called POMC Deficiency; this condition has symptoms of adrenal insufficiency and red hair (Krude et al., 1998). The fifth gene defect is called Melanocortin-4-Receptor Defect (Vaisse, Clement, Guy-Grand, & Froguel, 1998; Yeo et al., 1998). The sixth disorder is called Peroxisome-Proliferator-Activated Receptor γ -2 (PPAR γ -2) Defect (Ristow, Müller-Wieland, Pfeiffer, Krone, & Kahn, 1998).

Summary

Childhood obesity is a global issue, in 2010 there were more than 42 million overweight children worldwide (WHO, 2011). In the United States there were more than 12 million obese children. The obesity epidemic cost a lot of lives and money. There are many factors determine childhood obesity, include environmental, social, behavioral, and biological (including genetic).

Mothers' health and health behaviors (including maternal BMI and infant feeding methods) are some of the factors that may contribute to childhood obesity. Maternal weight and BMI may influence the child weight (Hediger et al., 2001). Children with maternal overweight or obese mothers have higher risk to be overweight than other

children (Wrotniak, 2008). Child birth weight and BMI is one of the factors that might influence childhood obesity (Gillman, 2004). Gaskins et al. (2010) report a positive association between small gestational age (birth weight below the 10th percentile) and childhood obesity; and a positive association between large gestational age (birth weight above the 95th percentile) and childhood obesity. Bavdekar and associate (1999) reported a study approve a positive correlation between birth weight and BMI level over a broad age range. Early postnatal health behavior in regard to infant feeding methods can influence childhood obesity. Breast fed or bottle fed practice has an important impact on a child's weight. As Hediger et al. reported that there was a significant reduction of risk for being overweight with children who were breastfed in some point in their childhood. Other factors such as gestational diabetes and biological (genes) factors might influence child weigh and BMI.

Chapter Three: Methodology

Introduction

This study examined mothers' health and health behaviors that may contributed to childhood obesity. In this chapter, the methodology used to gather data about specific mothers' health behaviors that influence childhood obesity are identified. The purpose of this research was to explore the relationship between mothers' health and health behaviors (maternal BMI and their infant feeding methods) and their children's BMI. This descriptive study explored childhood obesity. This study is to find answers to the following research questions:

1. What is the relationship between mothers' maternal BMI and infants BMI?
2. What is the relationship between mother's maternal BMI & infant's birth BMI?
3. Is there a difference in infant BMI when breast fed versus bottle fed?

Description of Research Design

The design used in this research was a non-experimental approach. Information was acquired by hospital data records (electronic medical records) of mothers' health behaviors (maternal BMI and their infant feeding methods) and their children's BMI. Prior to data collection for this research, permission was obtained from the following:

- 1) Mayo Clinic Health System in Mankato, MN (Institutional Review Board)
where the data was collected (see Appendix A).

- 2) Minnesota State University, Mankato Institutional Review Board (see Appendix B).

Instrumentation

A BMI pre-pregnancy weight chart was obtained from the CDC website to determine if the mothers of the sample were underweight, normal weight, overweight, or obese before the pregnancy (see Appendix C). Also, the study included maternal weight gain (gestational weight gain; the amount of weight gained from conception to delivery) table. The table indicated underweight, normal weight, overweight, and obese ideal weight gain from pre-pregnancy to delivery (see Appendix D). Weight's and length's chart of infants (birth to 36 months/ for both genders) (see Appendix E). The study included child length and weight percentiles because there is no BMI chart for children younger than 2 years old.

Data Collection

The data was collected by the hospital data collection staff, was coded and was given to the researcher. The data were obtained from Mayo Clinic Health System in Mankato, MN. The data examined mothers' health behaviors in regard to maternal BMI gain and the choice of their infants' feeding methods. The sample size was 307 mothers and 307 of their children who had regular doctor visits from birth to the age of six months. This data collection took three months, and started on April, 2012.

Data Analysis

Analysis of the data was done through descriptive statistics using SPSS.

Pearson's correlation was used to determine whether there was a significant relationship between maternal BMI and child BMI. Independent t-test was used to determine whether there was a significant difference between the mean of children BMI who were breast fed versus bottle fed. The data was reported by the use of frequencies, and percentages.

Descriptive statistics allowed the researcher to gain a better understanding of the relationship of mothers' health behaviors (maternal BMI and infant diet) and their children's BMI. The data was coded into SPSS.

Summary

The purpose of this study is to identify mothers' health behaviors that could contribute to childhood obesity. Some of these health behaviors are maternal BMI, and infant feeding methods. Understanding those factors affects into childhood obesity would give health professions new educational tools to prevent childhood obesity and obesity in general. This was a descriptive study was non-experimental in design and utilized a non-probability convenience sample. A sample of 307 mothers and 307 of their children was used with content and face validity obtained through an expert panel. The data was analyzed using SPSS to report frequencies, correlation, and percentages.

Chapter Four: Results and Discussion

Data was collected in four-months from electronic patients' records involving maternal BMI, their child's BMI, and their child's feeding methods (breast-fed or formula-fed). The findings were generated on the 614 (307 mothers & 307 children) participants through the use of descriptive statistics, Pearson correlation analysis, group statistics sample t-tests, and Independent sample t-tests. The low number of participants (only 614) limited the data; also, the ages of children (0-6 months) limited the data. While this number may be small in comparison to other studies, it does provide a picture of obesity and feeding methods of individuals in small southern Minnesota town.

The data was collected by Mayo Clinic Health System, Mankato, MN study staff; then all data was de-identified (in order to insure anonymity) by Mayo Clinic Health System, Mankato, MN study staff and distributed by secure file. After the approval of Mayo Clinic Health System, Mankato, MN IRB and the approval of Minnesota State University, Mankato IRB the file was transferred to the researcher for analysis.

Participants

There were 614 participants from a possible sample size of 8,000 (4,000 mothers & 4,000 children in the hospital electronic files). Subjects were selected from mothers and their children 0-6 months of age. The sample was taken from Mayo Clinic Health System, Mankato, MN. The mothers aged ≥ 18 ; all mothers had routine prenatal care at Mayo Clinic Health System, Mankato, MN. All participants received care in 2011; and

all participants have provided prior consent research authorization for records review; and assent for research authorization for records review of their eligible child.

Of the 614 participants 50% were mothers with successful outcomes of pregnancy, and 50% were children with regular follow up 0-6 months of age. Only 31% of the children participants were breast-fed right after birth, 8% were breast-fed at one month old, 6% were breast-fed at three months old, and 3% were breast-fed at six months old.

Of the sample size, the result did not support the hypothesis of the study (there is a relationship between maternal BMI and child BMI, and a relationship between infant feeding methods and infant BMI). This fact, along with the insufficient population size and the ages (0-6 months) of the children of the sample may have affected the results.

Result

Three research questions were being considered with the data collection and analysis.

1. What is the relationship between mothers' maternal BMI and infants BMI?
2. What is the relationship between mother's maternal BMI & infant's birth BMI?
3. Is there a difference in infant (0-6 months) BMI when breast fed versus bottle fed?

The study found no significant differences between children BMI who were breastfed and children BMI who were not breastfed. The relationship between maternal BMI and their infants' birth BMI analyzed with a Pearson R Correlation found no significant relationship. Mothers BMI was calculated before delivery and child BMI was collected after birth. The study examined the relationship between maternal BMI and child BMI at all times (0-6 months). The Pearson correlation analysis found no significant relationship between maternal BMI and child BMI at all times (0-6 months) at 0.05 level (2-tailed).

Discussion

The results from correlation data analysis between maternal BMI and newborn BMI were not similar to previous research findings. Other research, as stated above in chapter two, found that women who gained excessive maternal weight had newborns with more fat mass than newborns whose mothers gained the appropriate amount-17.5 ounces of fat compared with 13.9 ounces (Josefson, 2011). The small sample size may have affected the results. Having a larger sample size may have different results. Another limitation of the data was that the data did not include mothers' weight (BMI) prior to pregnancy to determine weight gain during pregnancy.

The results from data analysis shows no significant differences between children (0-6 months) breast-fed BMI and children (0-6 months) formula-fed BMI. Previous research has shown that breast-fed children have a lower BMI from formula-fed children

(Bergmann et al., 2003). Once again, small sample size may have limited the result; also the age of children (only 0-6 months) of the sample size may have affected the results. One of the surprising findings of this study was that there were only 31% of children in the sample that breastfed.

Maternal BMI had no relationship to children BMI at all times (0-6 months) at 0.05 level (2-tailed). The review of literature, in chapter two, has shown that maternal BMI can have a significant factor on their children BMI (Hediger et al., 2001). Small sample size may have limited the result; also the age of children (only 0-6 months) of sample size may have affected the results.

Chapter Five: Conclusions and Recommendations.

Introduction

Many researchers argued that maternal BMI might influence child BMI. Understanding that there is a relationship between maternal BMI and infant BMI will help contribute to effective ways to reduce the rate of childhood obesity. Being able to understand the relationship between maternal BMI and infant BMI is important in setting recommendation, education, and guideline of maternal weight. Birth weight (BMI) is one of the factors that might influence child BMI.

Breast-milk has an important impact on a child's weight and BMI. Most mothers of the data population do not practice healthy feeding methods (breastfed) for their children. Only 31% of the children in the data had breast-milk in some point in their infancy. Most researchers reported that there was a significant reduction of risk for being obese or overweight with children who were breastfed in some point in their childhood.

The World Health Organization (2010) estimated that there are more than 42 million overweight children worldwide (WHO, 2010). In the United States, there are 10% overweight children younger than two years old (Ogden et al., 2010). The effort to prevent childhood obesity will benefit economic and public health domains. Early prevention such as maternal health education is one stage of reduced the rate of childhood obesity and obesity in general.

The study conducted used a population of 307 mothers and their infants (307) from small southern Minnesota town. The population size was smaller than desired. Of the 307 infants in the data, only 95 infants had breastfed for their in some point of their infancy (0-6 months). The questions of this research were:

1. What is the relationship between mother's maternal BMI & infant's birth BMI?
2. What is the relationship between mothers' maternal BMI and infants (0-6 months) BMI?
3. Is there a difference in infant (0-6 months) BMI when breast fed versus bottle fed?

Conclusion

The conclusion of the study involved the limitation of an insufficient sample size and ages of the infants (0-6 months) of the sample. The Pearson correlation analysis found no significant relationship between maternal BMI and newborn BMI. An Independent t-test analysis found no significant differences between breastfed children's BMI and formula-fed children's BMI. There was no significant correlation in regard for maternal BMI and child BMI at all times (0-6 months) at 0.05 level (2-tailed). The results of the study were not similar to previous research findings that were presented in chapter two.

Recommendation for Health Educators

Childhood obesity is dramatically increasing and obesity in general at epidemic levels in the United States. From a health educator perspective, the best method to deal with obesity is prevention. There are three level of prevention: primary, secondary, and tertiary prevention. The primary prevention of childhood obesity aimed to decrease the number of overweight and obese children. In regard to mother's health behavior (prenatal weight, feeding method, and gestational diabetes), a health educator needs to encourage pregnant mother to maintain a healthy weight gain during her pregnancy. In regard to feeding method, a health educator needs to emphasize and promote the benefit of breastfeeding in lowering the incidence of childhood obesity. Regular health education programs for pre-pregnant mothers to promote maternal healthy lifestyle to reduce maternal health problems including gestational diabetes. Secondary prevention of childhood obesity aimed at reducing the current cases of childhood obesity. This can established after the child born; if the infant born with high birth weight and BMI, mother should advice to start breastfeeding method to lower the risk of her child to be obese. Also, gestational diabetic mothers should be informed about the risk of her newborn child of being at risk of obesity. Tertiary prevention of childhood obesity aimed at reducing the degree of disability (treatment) associated with childhood obesity then establishing healthy weight. A health care provider must notify the parents of obese child (regardless of the child age); then health care specialist should establish a program to help the child

to have a healthy weight. This study is a great tool for health care provider to educate parents on the early stage of preventing childhood obesity.

Recommendation for Future Studies

If researchers were to continue this research work further, researchers would expand the time of the study between one to two years retrospective study, with larger and more divers sample. Researchers would also consider demographic and socioeconomic characteristics of the sample to examine those influenced to childhood obesity. With a large sample size researchers could have an experimental group and control group (e.g. mothers with no health education sessions) to examine the studied variables influenced to childhood obesity. Finally, researchers would consider studying environmental, genetic, social, financial and other associated factors that would help researchers in understanding the complexity of the epidemic of childhood obesity.

Childhood Obesity Intervention

Maternal weight. The recommendation for mothers during their pregnancy is not be overweight or underweight (average weight gain between 25-35 pounds) (California Department of Public Health, 2009). Pregnant women health and health behaviors could have an effect on their child's birth weight. Maintaining healthy weight during pregnancy will most likely result in a healthy child at birth (California Department of Public Health).

Infant's diet. Today there are many bottle feeding brands which try to have the same nutrition and minerals as breast milk. The most common brands of infant formulas consumed by infants are made from cow's milk with added carbohydrate (usually lactose), vegetable oils, and vitamins and minerals (United States Department of Agriculture, nd). The protein in cow's milk is casein and the protein in breast milk is whey; most infant formulas brands have been altered to contain more whey. Despite that alteration, the protein in the breast milk is significantly different from that in infant formulas, because breast milk has different amino acid and protein composition (United States Department of Agriculture). Infant formula has nine percent of the kilocalories are provided by protein, around 50% by fat, and more than 40% by carbohydrate. These infant formulas are lower in fat and higher in carbohydrate, protein, and minerals than breast milk (United States Department of Agriculture, nd). Hediger and associates (2001) reported "Children fully breastfed for three months or longer were at about a 30% decreased risk for overweight" (Hediger, et al.).

Early childhood diet. After breast feeding or bottle feeding the child goes through another phase. Early childhood, two-five years of age, this is a significant period in a child's life. A child's diet is the responsibility of his or her parents. As recorded by Spear et al. (2007) there is no recommendation for the amount of nutrition required for a child. Yet, on the other hand, parents should not exceed one kind of nutrition over another kind of nutrient. In other words, the early childhood's "table food" should be nutritionally balanced. The United States Department of Agriculture recommends daily

food plan for children 2-5 years of age to include grains, vegetables, fruits, dairy, and protein (United States Department of Agriculture, nd).

For example, according to Spear et al. (2007), juices, should be limited to four or five ounces a day for children between one to six years of age. In the same study it was recommended, children should not consume soft drinks because there is a strong positive correlation between soft drinks and overweight children (Spear et al.). One of the carbohydrate diets most parents think that their children do not need is a fiber diet. Like adults, children need a high fiber diet. According to Spear et al., children are recommended to consume at least 10g of fiber per day. A fiber diet does not only maintain a child weight, but also prevents cardiovascular disease and diabetes (Spear et al.). Parents should, also, encourage their children to eat more varieties of carbohydrates, for example: unpeeled apples, green vegetables, whole grains, legumes, and nuts. A carbohydrate is one of the best sources for energy (Spear et al.).

Another significant intake diet for children is a dairy. As is well known, a dairy very important for the children's growth and development; especially calcium for the growth of bones (Spear et al., 2007). According to Spear et al., there are negative associations between calcium intakes and adiposity among children. A dairy intake is one of the best sources of fat for energy; therefore, it is very important for children's daily diet. In the same study of Spear et al., it was recorded more calcium intake was

associated with lower body fat on children. Therefore, it is clear that dairy can control the child's weight and help those who want to reduce their unwanted weight.

Eating behaviors. The problem of childhood obesity is not only what the children eat, but also their consumption patterns. Consumption patterns are where, when, and how much (amount) of food does a child eat. For example, a study by Spear et al. (2007) supports the risk factor for increased obesity among children who skip breakfast. Therefore, parents have the responsibility to establish behavior that will lead to healthy lifestyles for their children. Even on the weekends, when some families skip breakfast, parents should maintain the breakfast meal on the family's schedule. Research done by Rampersaud, Pereira, Girard, Adams, and Metz (2005) suggested that breakfast is the most important meal of the day, especially for children and for people who want to maintain their healthy weight.

Another behavior parents should be concerned about is snacking. Snacking is very common for many families; kids tend to eat snack between meals because of their energy needs. The problem is the amount of snacking. According to Spear et al. (2007) there is no association between frequency of snacking and childhood obesity; but there is a positive association between the amount of snack with high calories and childhood obesity. In most cases, a high amount of snacking may lead to skipping a meal where there is more nutritional value available; parents should limit the amount of snacking, so their children do not skip meals (Spear et al.).

Another prevalent eating behavior that may contribute to childhood obesity is eating out. With our lifestyle, most parents do not prepare meals at home; so they take their children to eat out. This is one of the negative effects on childhood obesity (Nicklas, Baranowski, Cullen, & Berenson, 2001). Even though parents are not responsible for the society's preoccupations with fast foods they are responsible for their children's food choices. For example, if parents decide to go to eat at McDonald's, where many families go, their children have a very few healthy choices. Some menu choices have 1,500 calories which is $\frac{3}{4}$ of the total calories a child needs for a whole day. Parents have the responsibility to make the right choice, where to eat, so they can avoid having obese children. Health education is the first steps in preventing childhood obesity. Health education regarding childhood obesity can start as early as pre-pregnancy, maternal, infancy, early childhood and beyond.

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Appendix A



Mankato
 1025 Marsh Street, P.O. Box 8673
 Mankato, Minnesota 56002-8673
 507-625-4031
 507-385-2925 TDD/TTY

April 5, 2012

Keith L. Stelter, M.D.
 Mayo Clinic Health System – EastRidge
 101 Martin Luther King Jr. Drive
 Mankato, MN. 56001

RE: Mothers' Health Behavior That Influenced Childhood Obesity".

Dear Dr. Stelter and Mr. Alammari:

The Institutional Review Board of Mayo Clinic Health System (MCHS) – Mankato reviewed the Investigator Checklist; IRB Protocol; Authorization to Use Medical Information for Medical Research consent; Conflict of Interest Disclosure forms; and proof of Protecting Human Subjects Training for the above named study proposal at its meeting on April 4, 2012.

Noting that all requirements for Criteria of IRB Approval of Research for this minimal risk study were met in accordance with federal regulations, approval is given as follows:

- to review only medical information of participants who have agreed to participate and who have signed the Authorization to Use Medical Information for Medical Research.
- to conduct your medical record review for a period of six months, from April 4, 2012 through October 3, 2012.
- for medical record and de-identified data to be reviewed by yourself and Mr. Alammari only.
- to seek IRB approval to continue or to close the study at the end of the six-month period granted.

The Board would very much like to see your proposal succeed and offers the following suggestions:

- **Consult with a statistician to ensure that the size of your study population is sufficient to account for the number of co-variables in your study (e.g. gestational diabetes, infant feeding methods, etc.). You may want to increase the size of your population or clarify that you require a minimum of 100.**
- **Revise your age group to either be ≥ 18 yrs. or state that the age range of 18-110 yrs. is provided to ensure that eligible participants will not be excluded.**

A written report will be due prior to October 3, 2012 that, according to federal regulations and IRB policy, should include the following:

- 1) The number of subjects in the study
 - 2) A summary description of the experience (benefits and adverse reactions)
 - 3) Summarize research activity and findings since initial review
 - 4) A current risk-benefit assessment based on the results to date
 - 5) Any new information or unanticipated risks found during the research
-

LETTER RE: Childhood Obesity Study
Page Two

- 6) Investigator intent to continue the study or intent to close the study; if possible, please estimate the study completion date

Any modification in the research protocol would need to be reported. Any adverse events that occur during the study at MCHS-Mankato should be reported to the Board as soon as possible, but no later than within five business days.

The deadline for submission to the IRB agenda is usually the 3rd Friday of each month. Thank you for your cooperation in complying with these reporting requirements.

Sincerely,



Victoria M. Hanson, LICSW – Vice Chair
Institutional Review Board

VMH/kmb

cc: Mr. Mohamed Alammari, MSU Student

Enclosures: Authorization to Use Medical Information for Medical Research consent
form – approved 4/4/12

Appendix B



April 17, 2012

Dear Margaret Murray-Davis, PhD:

Re: IRB Proposal entitled "[306274-2] motherhood health behavior that influence childhood obesity"
Review Level: Level I

Your IRB Proposal has been approved as of April 17, 2012. On behalf of the Minnesota State University, I wish you success with your study. Remember that you must seek approval for any changes in your study, its design, funding source, consent process, or any part of the study that may affect participants in the study. Should any of the participants in your study suffer a research-related injury or other harmful outcome, you are required to report them to the IRB as soon as possible.

The approval of your study is for one calendar year from the approval date. When you complete your data collection or should you discontinue your study, you must notify the IRB. Please include your log number with any correspondence with the IRB.

This approval is considered final when the full IRB approves the monthly decisions and active log. The IRB reserves the right to review each study as part of its continuing review process. Continuing reviews are usually scheduled. However, under some conditions the IRB may choose not to announce a continuing review. If you have any questions, feel free to contact me at patricia.hargrove@mnsu.edu or 507-369-1415.

Sincerely,

A handwritten signature in cursive script that reads "Patricia Hargrove".

Patricia Hargrove, Ph.D.
IRB Coordinator

A handwritten signature in cursive script that reads "Mary Hadley".

Mary Hadley, Ph.D.
IRB Co-Chair

Appendix C

Body Mass Index Table																																																						
	Normal					Overweight					Obese					Extreme Obesity																																						
BMI	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54																		
Height (inches)	Body Weight (pounds)																																																					
58	91	96	100	105	110	115	119	124	129	134	138	143	148	153	158	162	167	172	177	181	186	191	196	201	205	210	215	220	224	229	234	239	244	248	253	258																		
59	94	99	104	109	114	119	124	128	133	138	143	148	153	158	163	168	173	178	183	188	193	198	203	208	212	217	222	227	232	237	242	247	252	257	262	267																		
60	97	102	107	112	118	123	128	133	138	143	148	153	158	163	168	174	179	184	189	194	199	204	209	215	220	225	230	235	240	245	250	255	261	266	271	276																		
61	100	106	111	116	122	127	132	137	143	148	153	158	164	169	174	180	185	190	195	201	206	211	217	222	227	232	238	243	248	254	259	264	269	275	280	285																		
62	104	109	115	120	126	131	136	142	147	153	158	164	169	175	180	186	191	196	202	207	213	218	224	229	235	240	246	251	256	262	267	273	278	284	289	295																		
63	107	113	118	124	130	135	141	146	152	158	163	169	175	180	186	191	197	203	208	214	220	225	231	237	242	248	254	259	265	270	278	282	287	293	299	304																		
64	110	116	122	128	134	140	145	151	157	163	169	174	180	186	192	197	204	209	215	221	227	232	238	244	250	256	262	267	273	279	285	291	296	302	308	314																		
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75	152	160	168	176	184	192	200	208	216	224	232	240	248	256	264	272	279	287	295	303	311	319	327	335	343	351	359	367	375	383	391	399	407	415	423	431																		
76	156	164	172	180	189	197	205	213	221	230	238	246	254	263	271	279	287	295	304	312	320	328	336	344	353	361	369	377	385	394	402	410	418	426	435	443																		

Source: Adapted from Clinical Guidelines on the Identification, Evaluation, and Treatment of Overweight and Obesity in Adults: The Evidence Report.

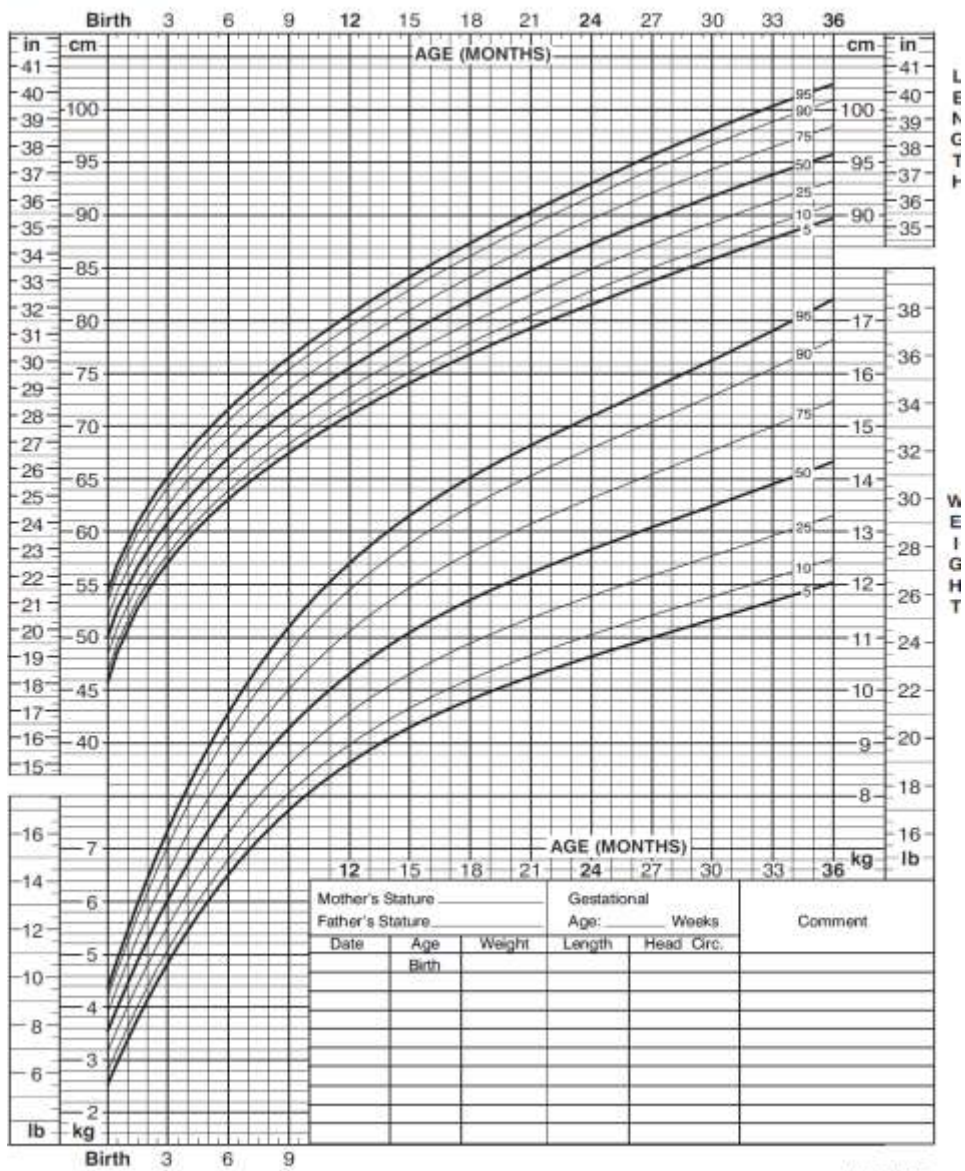
Appendix D

TABLE 2. The National Institute of Medicine's recommendations for acceptable/recommended weight gain during pregnancy	
BMI (KG/M ²)	RECOMMENDED WEIGHT GAIN (POUNDS)
<19.8	28-40
19.8-24.9	24-35
25.0-29.9	15-25
>29.9	15 (no upper limit)

Key: BMI=body mass index

Appendix E

Birth to 36 months: Boys NAME _____
 Length-for-age and Weight-for-age percentiles RECORD # _____

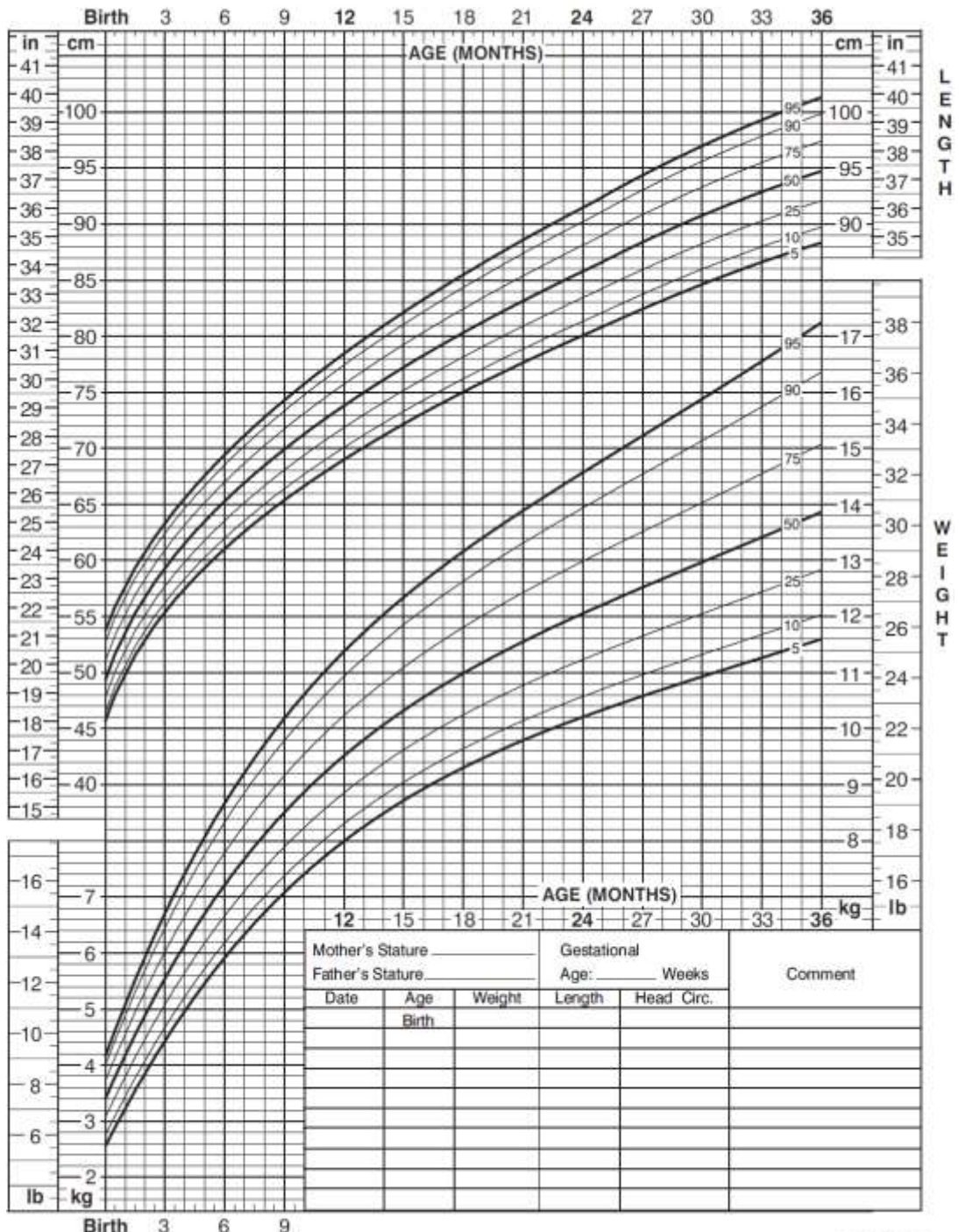


Published May 30, 2000 (modified 4/20/01).
 SOURCE: Developed by the National Center for Health Statistics in collaboration with the National Center for Chronic Disease Prevention and Health Promotion (2000).
<http://www.cdc.gov/growthcharts>

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BIRTH TO 36 MONTHS: GIRLS
Length-for-age and Weight-for-age percentiles

NAME _____
 RECORD # _____



Published May 30, 2000 (modified 4/20/01).
 SOURCE: Developed by the National Center for Health Statistics in collaboration with the National Center for Chronic Disease Prevention and Health Promotion (2000).
<http://www.cdc.gov/growthcharts>

