

UNIVERSITY OF WISCONSIN-LA CROSSE

Graduate Studies

PROLONGED BOTTLE FEEDING AND THE ASSOCIATION WITH OVERWEIGHT  
AND OBESITY: A RETROSPECTIVE STUDY OF WOMEN, INFANT, AND  
CHILDREN PROGRAM ENROLLED PARTICIPANTS  
THREE AND FOUR YEARS OF AGE

A Chapter Style Thesis Submitted in Partial Fulfillment of the Requirements for the  
Degree of Master of Public Health in  
Community Health Education

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December, 2009

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## ABSTRACT

Bradley, B. J. Prolonged bottle feeding and the association with overweight and obesity: A retrospective study of Women, Infant, and Children Program enrolled participants three and four years of age. MPH in Community Health Education, December 2009, 68pp. (R. D. Duquette)

This study investigated the connection between prolonged baby bottle use and weight status among Women, Infants, and Children (WIC) Program enrolled participants 3 and 4 years of age in Portage County, Wisconsin. WIC participants were enrolled in the study if they were 1) a resident of Portage County, WI; 2) 3 and 4 years of age; and 3) not exclusively breastfed up to 14 months of age. These inclusion criteria yielded a study population of 254 children. This study utilized a non-experimental quantitative causal-comparative research design. To determine if a causal relationship occurred between adiposity and prolonged bottle use, an odds ratio was calculated. The odds ratio was also used to determine if there was a relationship between prolonged bottle use and gender specific BMI. Bottle use was significantly associated with obesity ( $\geq 95$ th percentile) in males, but not with overweight ( $\geq 85$ th percentile) or obesity ( $\geq 95$ th percentile) in females. Finding prolonged bottle use had an effect on weight status among the heaviest study participants is consistent with findings from other researchers and documented trends among obese children.

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## CHAPTER I

### INTRODUCTION TO THE PROBLEM

#### Background

According to *Healthiest Wisconsin 2010* (2000), the state health plan, overweight and obesity are common health conditions and their prevalence is increasing on a local, state, and national level. Obesity has increased in every state, in both sexes, and across all age groups, races, and educational attainments (Institute of Medicine, 2004). Recent estimates suggest that one in two adults in the United States is overweight or obese, an increase of more than 25% in thirty years (Must, Spodano, Coakley, Field, Colditz, & Dietz, 1999). The obesity epidemic is also plaguing the future of the United States—its children. Obesity is reaching the very young at alarming rates; 12.4% of children 2-5 years of age are obese, for those aged 6-11 years 17% are obese, and those aged 12-19 years 14% are obese (United States Centers for Disease Control and Prevention (CDC), 2009).

Excess weight is associated with an increased incidence of many chronic conditions such as cardiovascular disease, type 2 diabetes, hypertension, stroke, and cancers (Centers for Disease Control and Prevention, 1999). These diseases, once considered adult diseases, are manifesting themselves within the obese and overweight pediatric population. According to the *Surgeon General's Call to Action to Prevent and Decrease Overweight and Obesity* (2001), high cholesterol, high blood pressure, type 2

diabetes, poor self esteem, and depression occur with increased frequency in overweight and obese children (Office of the Surgeon General, 2001).

Researchers Trasande, Liu, Fryer, and Weitzman (2009) analyzed data from the 1999-2005 Nationwide Inpatient Sample (NIS) to determine whether obesity related hospitalizations have increased. Data from 3.1 million hospital discharges of children 2-19 detected an increase from 21,743 in 1999 to 42,429 in 2005 for which obesity was listed as a diagnosis. Total costs for hospitalizations with a diagnosis of obesity increased from \$125.9 million in 2001 to \$237.6 million in 2005. Statistically significant increases in obesity related hospitalizations were found for asthma, pregnancy related conditions, diabetes, pneumonia, skin/subcutaneous tissue infections, appendicitis, mental disorders, and biliary tract disease. The morbidities resulting from childhood obesity may shorten life expectancy by 2-5 years by 2050 in the United States (Ludwig, 2007). This may be the first time in history when children are expected to have a shorter life expectancy than their parents.

According to the Centers for Disease Control and Prevention (CDC) (2007) “Overweight and obesity result from an energy imbalance. This involves eating too many calories and not getting enough physical activity” (p. 1). However, there is a lack of agreement on where the vector’s or “energy imbalance” root cause lies and whose responsibility it is to eradicate the vector (Stroup, Johnson, Proctor, Hahn, 2009). For instance, a poll conducted by Research!America and The Endocrine Society (2006), shows Americans named obesity as the top health issue for kids, but were split when determining who was responsible for finding a solution (Research!America, 2006). According to the poll, 52% of Americans think obesity is a public health issue that

society should help solve; while 46% say it is a private issue that people should deal with on their own.

As researchers uncover the causes of childhood obesity it appears there is no one root cause; instead it is multi-factorial. *Childhood Obesity*, a report released by the U. S. Department of Health and Human Services (2009) sites lack of physical activity, unhealthy eating, genetics, socio-economic status, race/ethnicity, media and marketing, and the physical environment as vectors for childhood obesity. Understanding these causes of obesity can provide a focused direction to efficiently address the problem.

### **Purpose of the Study**

The purpose of the study was to determine if prolonged bottle use past 14 months of age increased the risk for overweight and obesity among children 3-4 years of age within the Women, Infants, and Children (WIC) Program in Portage County, WI.

### **Statement of the Problem**

The research is conclusive that overweight and obese children are considerably more likely to grow-up and become overweight and obese adults compared to normal weight children (Baird, Fisher, Lucas, Kleijnen, Robersts, & Law, 2005; Office of the Surgeon General, 2001). For this reason researchers have focused their attention toward the causes of obesity among infants and toddlers as a means to put an end to the epidemic. Strong causal relationships exist between infant and toddler adiposity and maternal practices such as diet, weight, and smoking status, birth weight, race, socio-economic status, physical inactivity, and feeding practices (Barlow, 2007).

Infant and toddler feeding practices may be one of the most influential factors attributing to a caloric imbalance. Caloric imbalance was sited as the major risk factor for

obesity by the Centers for Disease Control and Prevention (2009). Feeding practices such as breastfeeding and bottle feeding can greatly influence caloric intake. Studies suggest that breastfeeding may help decrease risk for obesity, while bottle feeding may increase risk for obesity. In addition, research indicates prolonged bottle feeding causes elevated energy intake, increasing a child's risk of overweight and obesity (Stutcliffe, Khambalia, Westergard, Jacobson, Peer, & Parking, 2006).

The American Academy of Pediatrics recommends children wean from the bottle by 15 months of age (Guidelines for Health Supervision III, 1997). However, studies have reported prolonged bottle use from 20%-42% at age 2 and 9%-16% at age 3 (Bonuck, Huang, Fletcher, 2009; Safer, Bryson, Agras, & Hammer, 2001; Bonuck & Kahn, 2002; Kimbro, Brooks-Gunn, & McLanahan; 2007; Katse & Gift, 1995). The research indicates that increased rates of prolonged bottle use are associated with Hispanic ethnicity, less than high-school education, dental visits, and urban status (NHIS, 1991; Kaste & Gift, 1997). Although, a research study on primarily white, highly educated parents revealed a high rate of prolonged bottle use among toddlers past 15 months of age (Hammer, Bryson, & Agras, 1999). The researchers concluded that when a mother returns to work (3 months postpartum vs. 2 years) also affects duration of bottle feeding and should also be considered a risk factor. High rates of prolonged bottle feeding may be one factor attributing to increasing rates of overweight and obesity among infants and toddlers.

### **Need for the Study**

The majority of data collected to monitor trends in prolonged bottle feeding have been used to measure the status of Healthy People 2000 and 2010 objectives related to baby

bottle tooth decay and anemia. Prolonged bottle feeding as a risk factor for overweight and obesity remains largely under explored.

To date, only five studies have been published and three of them show significant association between prolonged bottle feeding and obesity and/or overweight. However, all three of the studies that found significant association between prolonged bottle feeding and obesity were lead by the same researcher (Bonuck & Kahn, 2002; Bonuck, Kahn, Schechter, 2004; Bonuck, Huang, and Fletcher, in press). This illustrates the need for further research before conclusions can be drawn upon the causal association between obesity and prolonged bottle feeding.

### **Research Question**

Are obese and overweight 3-4 year olds more likely to have been bottle-fed past 14 months of age than 3-4 year olds of a healthy weight?

### **Null Hypotheses**

1. Prolonged bottle use past 14 months of age will not significantly increase the risk for overweight among children 3-4 years of age within the Women, Infants, and Children (WIC) Program in Portage County, WI.
2. Prolonged bottle use past 14 months of age will not significantly increase the risk for obesity among children 3-4 years of age within the Women, Infants, and Children (WIC) Program in Portage County, WI.
3. Prolonged bottle use past 14 months of age will not significantly increase the risk for obesity and/or overweight among females 3-4 years of age within the Women, Infants, Children (WIC) Program in Portage County, WI.
4. Prolonged bottle use past 14 months of age will not significantly increase the risk

for obesity and/or overweight among males 3-4 years of age within the Women, Infants, and Children (WIC) Program in Portage County, WI.

### **Delimitations**

Delimitations for this study include geographic location and socio-economic status. The study included only children who reside in Portage County, WI. The results of this study can not be generalized to other locations.

The data obtained for the study was from the Women, Infants, and Children (WIC) program. Eligibility for this program is based on 185% of the US Department of Health and Human Services non-farm income poverty guidelines for gross income as seen in Table 1 (Wisconsin Department of Health Services, 2009). The results of this study can not be generalized to those outside of the income eligibility of the WIC program.

Table 1. WIC Income Eligibility Table for July 1, 2008- June 30, 2009

Family Size	Weekly Income	Bi-Weekly Income	Monthly Income	Annual Income
1	370	740	1,604	19,240
2	499	997	2,159	25,900
3	627	1,253	2,714	32,560
4	755	1,509	3,824	45,880
5	883	1,765	3,824	45,880
6	1,011	2,021	4,379	52,540
7	1,139	2,277	4,934	59,200
8	1,267	2,534	5,489	65,860
Additional	+129	+257	+555	+6,660

### **Limitations**

This study was limited by the self-reporting accuracy of the parents and caretakers of the study participants. Specifically, parents and caretakers provided information on bottle feeding/use. Any inaccuracies in these self-reports impact the study results.

### **Assumptions**

The following assumptions were made: (a) Women, Infants, and Children (WIC) Program client data entry is accurate and complete, (b) The parent/caretakers report of bottle use at point in time was honest, accurate, and complete, and (c) infant and toddler height and weight were taken by trained WIC staff using reliable and accurate measurement tools.

### **Definition of Terms**

Current literature pertaining to childhood and adult adiposity use the terms obesity and overweight interchangeably, however the terms have different meanings dependent on age, as the defining measurements used are age specific. The literature and the researcher also use the terms infant, toddler, childhood, and adolescent to indicate age and stage of development. In addition, definitions related to infant and toddler feeding includes breastfeeding, bottle feeding, and prolonged bottle feeding/use. Prolonged bottle feeding and prolonged bottle use are used interchangeably within the current literature and by the researcher and have the same meaning. The following terms will be used in the study.

**Overweight-** An adult who has a Body Mass Index between 25 and 29.9 (CDC, 2009).

**Obesity-** An adult who has a Body Mass Index of 30 or higher (CDC, 2009).

**Childhood Overweight-** A child who has a Body Mass Index at or above the 85th percentile and lower than the 95th percentile (CDC, 2009).

**Childhood Obesity-** A child who has a Body Mass Index at or above the 95th percentile (CDC, 2009).

**Body Mass Index-** Body Mass Index (BMI) is a number calculated from a person's weight and height. BMI provides a reliable indicator of body fatness for most people and is used to screen for weight categories that may lead to health problems (CDC, 2009).

**Pediatric Obesity-** Children and adolescents (aged 2-20 years) who are overweight or obese (CDC, 2009).

**Infant-** a child who is in the earliest stage of life, a time extending from the first month after birth to approximately 12 months of age, when the baby is able to assume an erect posture (Mosby, 2009).

**Toddler-** A child between 12 and 36 months of age (Mosby, 2009).

**Childhood-** the period in human development that extends from birth until the onset of puberty (Mosby, 2009).

**Adolescent-** A young person who has undergone puberty but who has not reached full maturity; a teenager (The American Heritage Medical Dictionary, 2007).

**Prolonged Bottle Feeding/Prolonged Bottle Use-** Children around 12-15 months of age drinking liquid from bottle-type containers (Guidelines for Health Supervision III, 1997; US Department of Agriculture, Food, and Nutrition Services, 2001).

**Bottle Feeding-** Feeding an infant or young child from a bottle with a rubber nipple on the end as a substitute for or supplement to breastfeeding (Mosby, 2009).

**Breastfeeding-** The act of providing milk to a newborn or infant from the mother's breast (Venes, 2001).

## **CHAPTER II**

### **REVIEW OF LITERATURE**

#### **Introduction**

The purpose of this study was to investigate the connection between prolonged baby bottle use and weight status among Women, Infants, and Children (WIC) Program enrolled participants 3 and 4 years of age in Portage County, Wisconsin. This literature review focused on the following: 1) the current rates and trends of obesity in the United States and Wisconsin; 2) morbidity related to childhood obesity; 3) the causes of obesity specific to infants and toddlers; 4) the current rates and trends of prolonged bottle use; and 5) the relationship between obesity and prolonged bottle use.

#### **Obesity Rates and Trends: United States & Wisconsin**

The prevalence of overweight and obesity has reached epidemic proportions in the United States. According to *Healthiest Wisconsin 2010* (2000), the state health plan, overweight and obesity are common health conditions, and their prevalence is increasing on a local, state, and national level. In fact, obesity has increased in both sexes, and across all age groups, races, and educational attainments (Institute of Medicine, 2004).

Obesity is defined as a Body Mass Index (BMI) of 30 or greater and overweight is defined as a BMI of 25 to 29.9. BMI is a measure of weight in relation to height that is used to determine weight status (CDC, 2009). For children and adolescents (aged 2-20 years), the BMI value is plotted on a growth chart to determine the corresponding BMI-for-age percentile. According to the 2000 CDC Growth Charts for the United States,

overweight is defined as a BMI at or above the 85th percentile and lower than the 95th percentile. Obesity is defined as a BMI at or above the 95th percentile for children of the same age and sex (CDC, 2009). In 2007, an expert committee added an additional category, BMI at or above the 99th percentile is labeled as “severe obesity” (Barlow S.E., 2007).

## **Adults**

The United States is far from reaching its Healthy People 2010 objective of an obesity prevalence less than 15%. In fact, Americans haven’t been this thin since 1980, almost three decades ago (NCHS, 2007). According to the 2008 Behavioral Risk Factor Surveillance System (BRFSS), 26.6% of Americans are obese and an additional 36.5% of Americans are overweight. The Sixth *annual F as in Fat: How Obesity Policies Are Failing in America* (2009) report from the Trust for America’s Health and the Robert Wood Johnson Foundation states that adult obesity rates increased in 23 states in 2008 and no state had a decrease in its obesity rate (Levi, Vinter, Richardsdon, Laurent, & Segal, 2009). However, rising rates of obesity have slowed since 2007. In the 2008 *F as in Fat* report, 37 states experienced an increase in 2007 (Levi, Richardson, Laurent, & Segal, 2008). According to the 2009 *F as in Fat* report, Wisconsin, which saw its obesity rate rise 0.6%, ranked 25th on the list, with 26% of its adults obese.

The 2008 *F as in Fat: How Obesity Policies Are Failing in America* report states, “Experts estimate that if we keep on the current course, 75% of Americans will be overweight or obese by 2015” (Levi, Richardson, Laurent, & Segal, 2008, p. 6). This statement is in stark contrast to the November 2007 National Center for Health Statistics (NCHS) *Obesity Data Brief* that stated there hasn’t been a significant increase in the

prevalence of obesity since 2004. Among men, the prevalence was 31.1% in 2003-2004 and 33.3% in 2005-2006. There was no statistically significant change. Among women, the prevalence in 2003-2004 was 33.2% and in 2005-2006 it was 35.3%. However, this report cautions that examining only changes in the prevalence of obesity does not accurately portray trends in weight or BMI among Americans. Between 1976-1980 and 2005-2006 the distribution of BMI has shifted to the right. This indicates that the entire adult population is heavier, and the heaviest have become much heavier since 1980.

Figure 1 illustrates the shifting of BMI to the right (NCHS, 2007).

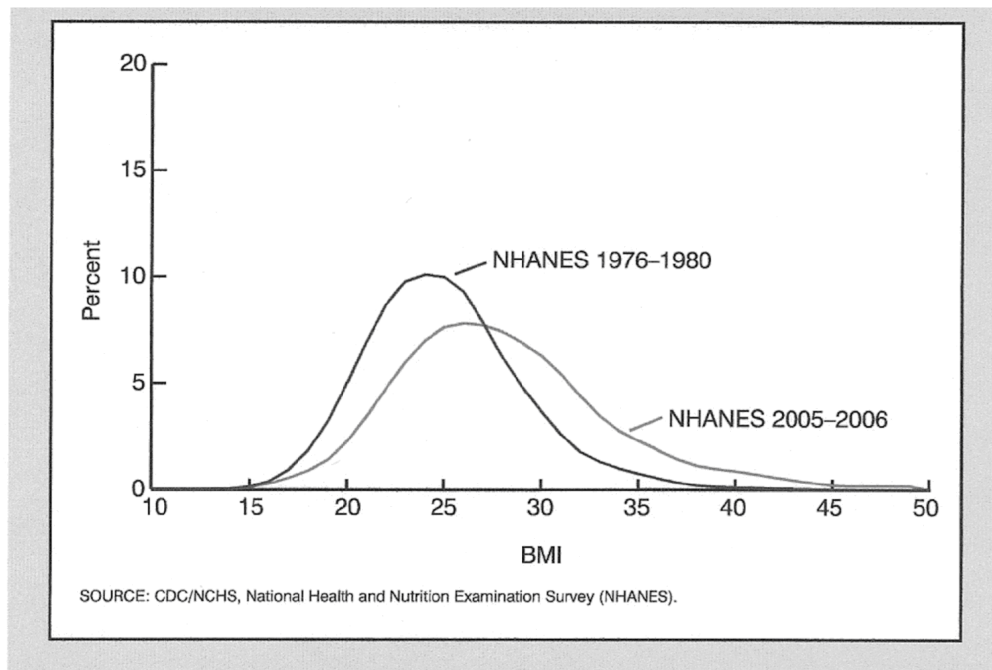


Figure 1. Changes in the Distribution of Body Mass Index (BMI) Between 1976-1980 and 1995-2006, Adults Aged 20-74 years: United States

This same shift of weight or BMI can be seen in Wisconsin. In 1990, 35% of the population was classified as obese and 12% as overweight. In 2008, 37.5% were classified as obese and 26% as overweight (Wisconsin Department of Health Services,

2009). Examining only obesity rates suggests that Wisconsin's waist line isn't expanding. However, the population of overweight adults has tripled in Wisconsin, an indication that similar to the nation, the state is also experiencing a shift in distribution of BMI. Figure 2 shows a shifting of BMI to the right as early as 2003 (Wisconsin Department of Health Services, 2009).

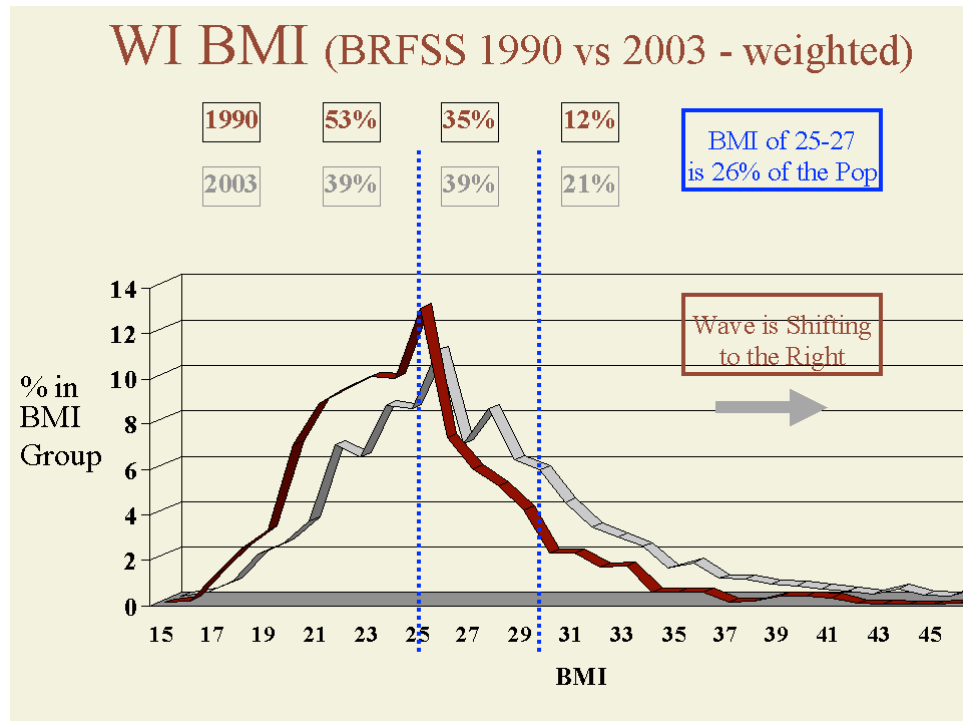


Figure 2. Changes in Distribution of Adult Body Mass Index (BMI) Between 1990-2003: Wisconsin

### Children and Adolescents

The rising rates of obesity and overweight are not an epidemic exclusive to the adult population in the United States. Data from the National Health and Nutrition Examination Survey (NHANES) (1976-1980 and 2003-2006) shows for children 2-5 years of age, prevalence of obesity has increased from 5% to 12.4%, for those aged 6-11 years prevalence increased from 6.5% to 17%, and those aged 12-19 years prevalence

increased from 5% to 14.6% (CDC, 2009). This data indicates that during the past three decades, childhood obesity rates have more than doubled, leading the United States further away from the Healthy People 2010 target prevalence of 5% (CDC, 2009; Institute of Medicine, 2004).

According to the CDC (2009), similar to the adult obesity epidemic, the childhood obesity epidemic has also appeared to have hit a plateau. However, in contrast to the adult obesity epidemic, the childhood obesity epidemic is not seeing a shift in BMI distribution to the right. Instead the heaviest group of children is getting heavier and the leanest group of children is staying lean. The Institute of Medicine (2004) supplied the following description:

The lower part of the BMI distribution appears to have changed little over time. For example, if 100 children were lined up from the lightest to the heaviest based on their BMI levels from the 1970s, and another line of children were lined up based on their BMI's from the 1990s, approximately the first 25 children in each line would have the same BMI. However the last 10 (the heaviest) children in the 1990s would be much heavier than his or her counterpart in the 1970s. (p. 1)

Based on 2007 Youth Risk Behavior Survey (YRBS) results, the obesity rate for Wisconsin high school students falls below the national rate (11% vs. 13%). Obesity rates for Wisconsin high school students have remained consistent between 1999 and 2007 (Liebhart, Wegner, & Pesik, 2008).

### **Infants and Toddlers**

The prevalence of obesity has even reached epidemic proportions among U.S. infants and toddlers, affecting 11% of 6-23 month olds (Ogden, Carroll, Curtin, McDowell, Tabak, and Flegal, 2002). According to researchers Kim, Peterson, Scanlon, Fitzmaurice, Must, and Oken, et al. (2006) the prevalence of overweight and obesity

among infants age birth to 11.9 months has increased substantially over the last two decades.

According to the National Health and Nutrition Examination Survey (NHANES), the percentage of toddlers ages 2-5 at or above the 85th percentile of BMI-for-age rose from 15.2% to 22.5% between 1988-1994 and 1999-2006. The increase for girls was smaller, but still considered substantial because it increased from 16.1% to 20.6% (Ver Ploeg, M., 2009). Currently in Wisconsin, 30% of children under the age of 5 are overweight or obese (Liebhart, Wegner, & Pesik, 2008). Between 1997 and 2006, obesity prevalence for children, aged 2 through 4, participating in WIC increased from 10% to 13%, and total overweight prevalence increased from 25% to 29%. Both rates were relatively consistent between 2003 and 2006 (Liebhart, Wegner, & Pesik, 2008).

Researchers Baird, Fisher, Lucas, Kleijnen, Roberts, and Law (2005) conducted a thorough literature review and identified 24 studies that described the relationship between infant growth or size and the development of overweight or obesity at later ages. Eighteen of the 24 studies examined infant size using Body Mass Index (BMI). Of the 18 studies:

- Six related infant size to obesity. Four found that infants who had been obese or who were in the highest end of the distribution for weight were more likely to be obese at age 5-7 years than non-obese infants.
- Five studies examined the stage of adolescence. Four found that larger size in infancy was related to increased risk of obesity at 9-18 years.
- Seven studies on adulthood. Three of these studies reported significant association between infant size and later obesity. Of the three, two showed that obese infants

were more likely to be obese as young adults at ages 20-30 years than non obese infants, and one study found that larger size at 6 months of age was associated with increased lifetime risk of obesity.

- Seven of the reviewed studies, two in children, one in adolescence, and four in adulthood, failed to show an association between infant size and obesity.

Ten of the 24 studies assessed the relationship between obesity and infant growth measured by weight gain. Of the ten studies:

- Seven studies found that more rapid growth in infancy was associated with greater risk of obesity at ages ranging from 4.5 to 20 years.
- Three studies, two in children and one in adolescents, failed to show an association between infant growth and later obesity.

This literature review conducted by Baird et al. (2005) suggests that both size and growth during infancy are related to risk of obesity in children and adults. This means obesity in infancy and childhood can lead to obesity in adulthood. According to the *Surgeon General's Call to Action to Prevent and Decrease Overweight and Obesity* (2001), overweight adolescents have a 70% chance of becoming overweight or obese adults. This increases to 80% if one or more parent is overweight or obese. This suggests that if intervention and prevention efforts are initiated early in life the obesity epidemic can be overcome.

### **Health Consequences of Pediatric Obesity**

The health affects associated with pediatric obesity can present early in life. In fact, some obesity related diseases once thought to only affect adults are affecting children in their early adolescents. According to the *Surgeon General's Call to Action To*

*Prevent and Decrease Overweight and Obesity* (2001) high cholesterol, high blood pressure, type 2 diabetes, poor self esteem, and depression occur with increased frequency in overweight and obese children. Ludwig (2007) predicted that pediatric obesity may shorten life expectancy by 2-5 years by 2050 in the United States. This would equal the devastating effect of all cancers combined. For these reasons, the US Department of Health and Human Service's *Expert Committee on Prevention, Assessment, and Treatment of Child and Adolescent Overweight and Obesity* recommends primary care providers universally assess children for obesity risk to improve early identification of elevated BMI, medical risk, and unhealthy eating and physical activity habits (Barlow, 2007). Medical risks from pediatric obesity include: type 2 diabetes, hypertension, elevated cholesterol, sleep apnea, asthma, fatty liver, gallstones, gastroesophageal reflux disease, polycystic ovary syndrome, hypothyroidism, orthopedic disorders, psychiatric disorders, and skin conditions (Barlow, 2007). Of these the more common medical risks are type 2 diabetes; cardiovascular risks such as hypertension and elevated cholesterol; and psychiatric disorders.

### **Type 2 Diabetes**

Type 2 diabetes was once considered an adult disease. Today however, type 2 diabetes accounts for over 40% of all new cases of diabetes among 10-19 year olds and may now surpass type 1 diabetes among Black and Hispanic children (Rocchini, 2002; Ludwig, 2007). The most important risk factor for type 2 diabetes in youth is a Body Mass Index (BMI)  $\geq$  85th percentile (Hannon, Gautham, Arslanian, 2005). The American Diabetes Association currently recommends screening with a fasting glucose test when a child is overweight ( $\geq$  85th percentile) and has two additional risk factors such as family

history of diabetes; Black, Hispanic, or Native American; and other related conditions such as polycystic ovary, acanthosis nigricans, or cardiovascular risk factors (American Diabetes Association, 2000; Barlow, 2007). Early detection of type 2 diabetes ensures early intervention and treatment, both are critical for delaying onset of complications such as neuropathy, retinopathy, nephropathy, cardiovascular disease, and in some cases, sudden death (Hannon, Goutham, Arslanian, 2005).

### **Cardiovascular Disease**

According to the *Surgeon General's Call to Action to Prevent and Decrease Overweight and Obesity* (2001), "risk factors for heart disease, such as high cholesterol and high blood pressure, occur with increased frequency in overweight children and adolescents compared to children with a healthy weight" (p. 1). The Institute of Medicine (2004) states 60% of obese children 5-10 years old have at least one cardiovascular disease risk factor and 25% have two or more. According to Daniels and Greer (2008), the strongest risk factors for cardiovascular disease include elevated concentrations of low-density lipoprotein (LDL), a low concentration of high-density lipoprotein (HDL), elevated blood pressure, type 1 and 2 diabetes, tobacco use, and obesity.

Due to the increase in cardiovascular disease risk associated with the obesity epidemic, the American Academy of Pediatrics (1992) recommends cholesterol screenings on children with a family history of premature cardiovascular disease or high cholesterol, who are overweight, have hypertension or diabetes, and/or smoke. Cholesterol screening is recommended as early as age 2 and no later than age 10 if risk factors are present (American Academy of Pediatrics, 2008). A study conducted by Williams, Going, Loham, Harsha, Sathanur, Srinivasan, et al. (1992) of 3,320 biracial

children and adolescents 5-18 years of age revealed males with a body fat  $\geq 30\%$  were 1.6 times more likely to have an elevated total cholesterol as those in the leanest group ( $< 10\%$  body fat). Females within the study population who had a body fat between 30%-34.9% were 2.1 times more likely to have elevated total cholesterol as those in the leanest group ( $< 20\%$  body fat).

With little dispute between researchers, obesity has proven to be a risk factor for elevated blood pressure. For example, a study conducted by Becque, Katch, Rocchini, Marks, and Moorehead (1988) found that 64% of obese adolescents had elevated systolic blood pressure and 39% had elevated diastolic blood pressure. A study conducted by Freedman, Khan, William, Srinivasan, and Berenson (2001) found in a study population of 2,617 5-18 year olds a more modest incidence of elevated blood pressure among overweight children (Freedman, Khan, William, Srinivasan, & Berenson, 2001; Barlow, 2007). Within the study population, approximately 13% of overweight children had elevated systolic blood pressure and 9% had elevated diastolic blood pressure. According to Reily, Methven, McDowell, Hacking, Alexander, Stewart, et al. (2003) cardiovascular effects of pediatric obesity, such as elevated cholesterol and blood pressure, tend to persist into adulthood, which allows for the prediction of future morbidity and mortality rates as obese children become adults.

### **Psychiatric Disorders**

Obesity in childhood has also been linked to psychiatric disorders such as depression and low self-esteem. According to the *Surgeon General's Call to Action to Prevent and Decrease Overweight and Obesity* (2001) the most immediate consequence of childhood overweight and obesity is perceived social discrimination which is

associated with poor self-esteem and depression. A study conducted by Strauss (2000) found that 34% of White and 37% of Hispanic obese 13-14 year old females had low self esteem compared to 8% White and 9% Hispanic non obese females in the same age group. However, Strauss (2000) was unable to find a significant decrease in self-esteem among obese Black, Hispanic, and White males and Black females 13-14 years of age.

Based on an extensive literature review, researchers Reilly, Methven, McDowell, Hacking, Alexander, Stewart, et al. (2003) stated, “we can conclude that obese children are more likely to experience psychological or psychiatric problems than non-obese children, that girls are a greater risk than boys, and that risk of psychological morbidity increases with age” (p. 748-748). The US Department of Health & Human Service’s *Expert Committee on Prevention, Assessment, and Treatment of Child and Adolescent Overweight and Obesity* advises all clinicians to consider flat affect, anxiety, body dissatisfaction, excess eating, fatigue, and difficulty sleeping as risk factors for psychiatric disorders among obese patients (Barlow, 2007).

The health effects of pediatric obesity can be felt in the wallet as the economic impact of obesity in childhood is considerable. Researchers Trasande, Liu, Fryer, and Weitzman (2009) obtained data from the 1999-2005 Nationwide Inpatient Sample of 3.1 million hospital discharges of children 2-19 years of age. The researchers found costs for hospitalizations with a diagnosis of obesity increased from \$125.9 million in 2001 to \$237.6 million in 2005. The increases in costs were due to a near doubling in hospitalizations between 1999-2005. The researchers concluded that their analysis provides data that can be used to estimate the economic benefits of interventions.

## **Causes of Obesity in Infants and Toddlers**

Understanding the causes of obesity among infants and toddlers permits a focused approach to efficiently address the problem and expedite a reduction of negative health consequences. A report by the United States Department of Health and Human Services titled *Childhood Obesity* (2005) states that overweight in children is multi-factorial but is generally caused by physical inactivity, unhealthy eating, and lifestyle behaviors leading to excess energy intake. This same report states that genetics, socio-economic status, race/ethnicity, media and marketing, and the physical environment may also influence energy consumption and expenditure. Specific to toddlers and infants, researchers are linking obesity to maternal practices such as diet, weight, and smoking status, birth weight, race, socio-economic status, and feeding practices (Barlow, 2007).

### **Maternal Practices**

During gestation, risk factors for obesity can include maternal weight, diet and smoking. Several researchers have linked childhood obesity to maternal obesity. For instance, a retrospective study conducted by Whitaker (2004) of 8,494 low-income children enrolled in the Ohio WIC program found children whose mothers were obese during early pregnancy were more likely to be overweight during their preschool years (OR: 2, 95% CI: 1.7-2.3). Researchers Salsberry and Reagan (2005) found children were more likely to be overweight if their mother's pregnancy BMI was  $\geq 30$  (OR: 1.37, 95% CI: 1.26-2.15). Dubois and Girard (2006) population study of 2,103 children born in 1998 in Canadian Province of Quebec found overweight at 4.5 years was positively related to parental overweight or obesity (OR: 2, 95% CI: 1.3-3.1).

What a woman eats or does not eat during pregnancy can have an effect on the weight status of a child early and later in life. For instance, high carbohydrate intake in early pregnancy combined with low dairy and meat protein intake in late pregnancy has been associated with low birth weight— a risk factor for obesity (Godfrey, Robinson, Barker, Osmand, & Cox, 1996; Esposito, Fisher, Mennella, Hoelscher, & Huang, 2009). A study conducted on rats indicated a maternal diet high in fat is associated with increased adiposity among female offspring (Khan, Dekou, Douglas, Jensen, Hanson, & Poston, et al., 2004). Maternal diet also has the ability to instill healthful feeding practices. For example, prenatal and early postnatal exposure to flavors through amniotic fluid and breast milk enhanced the infants enjoyment of these flavors in solid foods as they were weaned from the breast or bottle (Mennella, Coren, Jagnow, & Beauchamp, 2001).

Smoking during pregnancy not only causes low birth weight, it now is proven to cause obesity beginning in adolescents that progresses into adulthood. A study conducted by Power and Jefferis (2002) found infants of mothers who smoked during pregnancy weighed less at birth than babies born to nonsmokers. In fact, as they reached adolescence, children exposed to tobacco in utero had a significantly greater risk of being in the highest 10% of BMI for their age group (Power & Jefferis, 2002). Research conducted by Dubois et al. (2006) support Power's et al. (2002) findings. Dubois et al. found maternal smoking during pregnancy to have one of the largest effects on childhood overweight in the studied population. In addition, a study conducted using data from the National Longitudinal Survey of Youth's Child-Mother file found in a study sample of 3,022, children whose mothers smoked during pregnancy were more likely to be

overweight (OR: 1.37, 95% CI: 1.08-1.73) (Salsberry & Reagan, 2005). According to researchers Esposito, Fisher, Mennella, Hoelscher, and Huang (2009) the relationship between smoking during pregnancy and children's overweight is well documented. However, researchers Esposito, Fisher, Mennella, Hoelscher, and Huang stated the mechanisms identified such as low birth weight, poor placental blood supply, and fetal exposure to carbon monoxide still warrant more research.

### **Socio-Economic Status**

Several studies have documented the association between obesity and economic status. As an example, a 2007 survey of low-income children ages 2-5 called the Pediatric Nutrition Surveillance Survey (PedNSS) found that 14.9% of low-income children were obese compared to 12.4% for U.S. children of the same age group (Polhamus, Dalenius, Borland, Mackintosh, Smith, & Grummer-Strawn, 2009). A 2009 report issued by the United States Department of Agriculture (USDA) titled *WIC and the Battle Against Childhood Overweight* stated low-income status, especially for Mexican-American children, does raise the probability of a child being at risk for overweight (Ver Ploeg, 2009). In addition, researchers Dubois et al. found children born to households with income less than \$20,000 per year were more likely to have a BMI  $\geq$  95th percentile ( $p = .0308$ ). However in Salsberry's et al. (2005) research, socio-economic status was not a significant factor relating to overweight and obesity.

### **Race/Ethnicity**

Results from three cross-sectional logistic models, performed at three different intervals by researchers Salsberry & Regan (2005) found a strong relationship between race and weight status ( $p < .001$  at all three intervals). At the earliest interval, Black (OR:

1.65, 95% CI: 1.24-2.07) and Hispanic (OR: 1.65, 95% CI: 1.26-2.15) individuals were more likely to be overweight than white individuals. Study results from Kimbro, Brooks-Gunn, and McLanahan (2007) found an additional risk factor for obesity associated with race and ethnicity. In this study, Hispanic children were twice as likely as either Black or White children to be overweight or obese. Within the study sample there were large ethnic disparities among children who took a bottle to bed; 14% of Hispanic children took a bottle to bed as compared to 6% of White children and 4% of Black children. In addition, the study found taking a bottle to bed nearly doubled the odds of overweight and obesity at age 3 years. Taking a bottle to bed is often associated with prolonged bottle use, an emerging risk factor for obesity.

### **Birth Weight**

Additional analysis of research completed by Dubois & Girard (2006) indicates at 4.5 years, the odds of being at the 95th percentile or higher for Body Mass Index (BMI) are lower for children born with weights between 2500 and 2999g. The odds are higher for children with birth weights of more than 4000g. Supporting these findings are researchers Kimbro, Brooks-Gunn, and McLanahan (2007) who found within a 3 year old low-income population, children in the low birth-weight category had lower odds of overweight and obesity when compared with children in the normal birth-weight category. In fact, children in the high-weight category had more than twice the odds of overweight or obesity. However, these findings are inconsistent with other researchers who believe it is the low birth-weight of newborns born to smoking mothers that puts them at risk for overweight and obesity because they often have a catch up period in weight gain during their first year. Although, a literature review conducted by Esposito et

al. (2009) cautions that studies have not consistently found a link between catch-up growth and greater childhood BMI.

### **Media/Marketing**

Research indicates that a decrease in daily energy expenditure without a decrease in total energy consumption may be the underlying factor for the increase in childhood obesity (US Department of Health & Human Services, 2005). Researchers Caroli, Argentieri, Cardone, and Masi (2004) reported that one of the most sedentary behaviors in childhood is television viewing. They feel television viewing replaces more vigorous activities, and at the same time, could expose children to a large number of unhealthy stimulations influencing food intake. Their conclusion that screen time is correlated to weight status is consistent with Gortmaker, Must, Sobol, Peterson, Graham, Colditz, et al. (1996) who found the odds of being overweight was 4.6 times greater for children watching more than 5 hours of television per day, compared with those watching for 0-2 hours.

Research by Mendoza, Zimmerman, and Christakis (2007) of preschool aged children 2-5 years (average age 3.5 years) found that both media use and television/video viewing were associated with weight status. Compared to children who watched 2 hours or less of TV/videos on the study assessment day, those who watched greater than 2 hours were more likely to be overweight or at risk for overweight (PR: 1.34, 95% CI: 1.07-1.66). Media use for more than 2 hours on the day of assessment was not associated with higher weight status. In fact, researchers Graf, Pratt, Hester, and Short (2009), found in a study of 14 boys and 9 girls, children who play interactive video games use similar amounts of energy as walking 2.6 mph. The findings also stated study subjects burned

three times as many calories using interactive video games as they did while watching television.

Researchers Caroli et al. (2004) indicate that the number of TV commercials targeting children has increased at the same rate as childhood obesity. In the late 1970s, the estimated average number of advertisements viewed by children in the US was about 20,000 advertisements per year; today that estimate has doubled to 40,000 per year (Kunckel, 2002). Researchers Caroli et al. commented in response to this statistic:

This shocking increase has a very good reason. Children and adolescents have by now acquired a remarkable purchase power, which is based on the money made available by their parents and by their power to influence family decision-making when buying products. (p. S106).

They quote the New York Times which reported, “this influence has been calculated to amount to about \$200 billion in 2004” (Caroli, Argentieri, Cardone, and Masti, 2004, p. S106).

Halford, Boyland, Hughes, McKean, and Dovey (2008) found in an experiment, viewing children’s food advertisements caused children to eat much larger portions of snack foods compared to children who watched a control (toys) advertisement ( $p < .001$ ), and the effect was significantly larger on obese children (increase of 155%) than on normal-weight children (increase of 89%) ( $p < .004$ ). Researchers Borzekowski and Robinson (2001) found exposure to food advertising can influence short-term food preferences of preschool children. The food preference effect doubled if the same advertisement was shown twice during the same break. Analysis by the National Bureau of Economic Research estimates that eliminating fast-food restaurant advertising would reduce the prevalence of overweight children 3-11 years of age by 18% and overweight children 12-18 years of age by 14% (Chou, Rashad, Grossman, 2008).

Research conducted by Burdette and Whitaker (2005) indicates that more may be influencing obesity than a decrease in daily energy expenditure from TV viewing and media use. Their study of 2,620 children 36 months of age from 20 large US cities in 15 states found TV viewing and outdoor play time were not significantly correlated to each other or to BMI.

### **Early Life Feeding Practices**

The Centers for Disease Control and Prevention (CDC) (2009) states that obesity is a result of caloric imbalance that is influenced by genetics and health. Feeding practices such as breastfeeding and prolonged bottle feeding can greatly influence caloric intake. Studies suggest that exclusively breastfeeding or breastfeeding to one year of age may help prevent pediatric obesity. According to the CDC (2007), breastfeeding protects against overweight and obesity, while infants who are bottle fed are at a 15%-30% greater risk of obesity. (CDC, 2007). The CDC (2007) also stated breastfeeding exclusively and for a longer duration can maximize the level of protection. However, research by Lawrence, Hammer, Bryson, and Agras (1999) found in a sample of 191 infants that although 90 percent of mothers breastfed during the first month of life, by 6 months 48 percent were breastfeeding, at 1 year only 19 percent were breastfeeding. This same trend was reported by the Wisconsin Department of Health Services who reported rates of breastfeeding of 72.1% at one month of age and 18.3% at one year of age (Liebhart, Wegner, & Pesik, 2008).

For those infants who are partially or exclusively bottle fed, research indicates that they are at an increased risk for obesity, and an even higher risk if bottle use is prolonged beyond 12 months (Bonuck, Huang, Fletcher, 2009). Bottle use can lead to a

higher beverage intake putting a child at risk for an elevated energy intake (Stutcliffe, Khambalia, Westergard, Jacobson, Peer, & Parking, 2006). O’Conner, Yang, and Nicklas (2006) found that children 2-5 years of age who drank more servings of milk consumed greater total energy than children who drank less milk ( $p < .01$ ). However, the increase in energy consumption was not significantly associated with weight status. The researchers caution that several limitations within the study could be responsible for not exposing a significant correlation to BMI such as a small proportion of overweight children in the study population (10.7%) and an average milk consumption (1.5 servings) among the study population below the 2005 Dietary Guidelines for Americans (2 servings).

Researchers Johnson, Clark, Goree, O’Connor, and Zimmer (2008) examined healthcare professionals’ perceptions of variables thought to contribute to infant obesity in the Mexican-American community in Denver, CO. Five focus groups were used to contribute insights from 38 healthcare providers. “Mothers delaying weaning from the bottle” was one of six themes that emerged from the focus groups.

According to Johnson et al. (2008): Providers vigorously supported that Mexican American mothers promote over-consumption of energy by prolonging the duration of bottle use and providing non-milk liquids well into early childhood (up to 4 years of age). (p. 185)

Although this is only anecdotal, it points to the need for additional research on the connection of prolonged bottle use to overweight and obesity among toddlers. The remainder of this literature review will focus on the trends and research related to prolonged bottle use.

### **Trends in Prolonged Bottle Use**

The American Academy of Pediatrics (AAP) guidelines recommend that children should be weaned from the bottle by 15 months of age (Guidelines for Health

Supervision III, 1997). However, the National Health Interview Survey (NHIS) of Child Health (n = 3,551), completed last in 1991, found 8.3% of American children 2-5 years of age continue to receive some caloric intake through a bottle (NHIS, 1991). The NHIS of Child Health also found that 20% of 2 year olds and 9% of 3 year olds still used a bottle. Bottle use in children aged 2-5 years is significantly associated with Hispanic ethnicity, less than high-school education, and urban status. Among populations with Hispanic ethnicity, 18.5% of 2-5 year olds used a bottle compared to those with non-Hispanic ethnicity at 6.5% of 2-5 year olds. Adults with less than a high school education fed their 2-5 year old with a bottle more (16%) than adults with a high school education (6.4%). Urban status also had an effect on prolonged bottle weaning. Children who lived in an urban area were more likely (11.4%) to receive a bottle past 2 years of age than those who lived in a rural area (4.9%).

Studies conducted since 1991, have found an even higher rate of prolonged bottle feeding. For example, Hammer, Bryson, and Agras (1999), found that 42% of the children in the Stanford Infant Growth Study (n = 191) received a bottle after 2 years of age and 16% after 3 years of age (Hammer, Bryson, & Agras, 1999). More interesting, these children were from primarily white, highly educated parents, showing a strong disconnect from the results of the 1991 NHIS of Child Health. These same researchers studied family variables in feeding practices and found that mothers who returned to work during the first 3 months postpartum bottle-fed longer than those who returned to work later or not at all in the first 2 years. They also examined, but did not find a significant relationship between prolonged bottle use and birth order, maternal age, and maternal educational attainment.

Researchers Kaste and Gift (1997) conducted a similar study also using data from the 1991 National Health Interview Survey. Bivariate and multivariate analysis showed difference in bottle practices by education level of the adult caretaker, dental visits, Hispanic background, and geographic region. Hispanic background contributed strongly to prolonged bottle use whereas education made borderline contributions. Living in an urban location was an indicator for prolonged bottle use when compared to those living in a rural location. In addition, dental visits decreased prolonged bottle use. However the correlation was stronger for children who had two or more visits when compared to children with one dental visit.

The identified and well known major risks of late bottle weaning include dental caries and iron deficiency (Kaste & Gift, 1997; Kwiatkowski, West, Heidary, Whitley, & Cohen, 1999). Trends in prolonged bottle use have been studied as a means to monitor status of the Healthy People 2000 and 2010 objectives related to baby-bottle tooth decay and anemia. Late bottle weaning and/or inappropriate bottle use is a risk factor for overweight and obesity and remains largely under explored.

### **Obesity and Prolonged Bottle Feeding**

To date, only five studies have been published and three of them show significant association between prolonged bottle feeding and obesity and overweight. The first study conducted by Safer, Bryson, Agras, and Hammer (2001), was a sub-study of the Stanford Infant Growth Study, an ongoing longitudinal study. Children (n = 165) with an average of 3.5 years of age participated in this home feeding study to determine differences between weaned bottle groups and non-weaned bottle groups in relation to consumption of calories, Body Mass Index (BMI), iron and calcium intake, and nutritional

composition. The study found non-weaned children drank more milk ( $p < 0.001$ ) than weaned children, however, there were no significant differences between the non weaned and weaned children in terms of juice consumed, mean caloric intake, mean BMI, or total iron intake (Safer, Bryson, Agras, & Hammer, 2001). Researchers concluded that finding no significant difference between caloric intake or BMI helped confirm that children of this age (3.5 years) are capable of the kind of self -regulation found by researchers, such as Brich, Johnson, Anderson, Peters, and Schulte (1991). However, researchers DiMeglio and Mattes (2000) and O'Conner, Yang, and Nicklas (2006), indicate that excess intake of energy dense liquids, such as whole milk can lead to increased intake of other foods.

The second study was conducted shortly after by Bonuck and Kahn (2002) to determine whether prolonged bottle feeding was associated with increased BMI and/or Iron Deficiency Anemia (IDA). Ninety-five children aged 18-56 months enrolled in several Bronx, New York, Women Infants and Children (WIC) supplemental Feeding Programs participated in the seven day study. Half of the sample was overweight and two thirds (63%) received daily bottles of milk or sweet liquids. This was significant at the 95% BMI ( $p < 0.05$ ) and nearly significant at the 85% BMI ( $p < 0.06$ ). Researchers caution that they conducted a descriptive study that measured bottle use and overweight at one point in time and causality can not be assumed (Bonuk & Kahn, 2002).

Researchers Bonuck, Kahn, and Schechter (2004) were the first to exclusively study prolonged bottle feeding and its association with overweight and obesity as an analysis of NHANES III data. Based on preliminary findings, researchers Bonuck, Kahn, and Schechter conducted this study using a sample of 2,979 children to determine the relationship between prolonged bottle feeding and overweight and obesity. In this study a

multivariate model was used for predicting child BMI based on duration of breast feeding, age off bottle, mothers BMI, birth weight, and race. Bottle weaning was significantly associated with child BMI level ( $p < .01$ ); each additional month of bottle use corresponded to an approximate 3% increase in the odds of being in a higher BMI category ( $p < .01$ ). Birth weight also contributed significantly ( $p < .05$ ). Maternal BMI had approximately three times the effect of weaning age ( $p < .01$ ). Breastfeeding duration was not significant in this model. The major weakness in this study was the self-report by parents of bottle weaning age (Bonuck, Kahn, & Schechter, 2004).

The most recent study conducted was by researchers Bonuck, Huang, and Fletcher (in press) who examined prolonged bottle use among 150 lower income 1-5 year olds. Current bottle users 12-36 months of age were more likely to be obese compared with children who had weaned ( $p = .02$ ). However, overweight among current bottle users 12-36 months of age and overweight and obesity among current bottle users 37-60 months of age was not significant. Finding an association between prolonged bottle use, implying increased energy intake, and effect on weight status among the heaviest children ( $\geq 95$ th percentile) is consistent with pediatric obesity trends reported by the CDC and Institute of Medicine (Bonuck, Huang, & Fletcher, in press; CDC, 2009; Institute of Medicine, 2004).

Additional studies related to bottle use highlight the need for supplementary research. Kimbro, Brooks-Gunn, and McLanahan (2007) conducted a study on racial and ethnic differences in obesity and overweight among 3 year old children and found there were large ethnic disparities in whether children took a bottle to bed. More importantly, they found that taking a bottle to bed nearly doubled the odds of overweight and obesity

at age 3 years. More research is needed to determine if it was the effect of taking a bottle to bed or prolonged bottle use to age 3 that increased odds of becoming overweight or obese.

In summary, this literature review supports the need for additional research into the association between prolonged bottle feeding and pediatric obesity and overweight based on: 1) evidence that pediatric obesity rates have increased substantially over the last two decades; 2) pediatric obesity is a risk factor for serious health complications progressing into adulthood; 3) prolonged bottle feeding has been associated with increased energy intake, placing a child at risk for pediatric obesity; 4) lack of research on prolonged bottle feeding and its association to pediatric obesity and overweight; and 5) a definitive conclusion is unable to be drawn from the current research.

## **CHAPTER III**

### **METHODS AND PROCEDURES**

#### **Introduction**

The purpose of the study was to determine if prolonged bottle use past 14 months of age increased the risk for overweight and obesity among children 3 and 4 years of age within the Women, Infants, and Children (WIC) Program in Portage County, WI.

This chapter will address the following topics: 1) research design; 2) study participants; 3) data collection; and 4) statistical analysis.

#### **Research Design**

The study utilized a non-experimental quantitative causal-comparative research design. The study designed by the researcher was informed by similar studies investigating the relationship between adiposity and prolonged bottle use. The causal-comparative study design permitted the researcher to determine the cause for differences (overweight vs. normal weight) that exist between two different groups of individuals (prolonged bottle use vs. weaned < 14 months) (Cottrell & McKenzie, 2005). The quantitative design allowed for measurement of prolonged bottle use in relationship to Body Mass Index (BMI). The quantitative research design also allowed for analysis of the correlation between prolonged bottle use and gender specific BMI.

#### **Study Participants**

The Wisconsin WIC program is for low-income and at-risk pregnant, breastfeeding and postpartum women, infants, and children. To be eligible for WIC, participants must:

1) be pregnant, breastfeeding or have a baby less than 6 months old; 2) be an infant or child up to age 5; 3) be a resident of Wisconsin; 4) be income eligible; and 5) have an identified health or nutrition risk. Income eligibility is based on 185% of US Department of Health and Human Services poverty guidelines (WI Department of Health Services, 2009).

WIC participants were enrolled in the study if they were 1) a resident of Portage County, WI; 2) 3 or 4 years of age; and 3) not exclusively breastfed up to 14 months of age. Based on these inclusion criteria 255 children were identified. One participant was excluded from the study due to the unknown age at which the child was weaned from the bottle, yielding a study population of 254 children.

### **Data Collection**

To gain access to confidential WIC participant data, the researcher met with the Manager of the Portage County WIC program and the Public Health Northern Regional Office to gain approval. Approval was granted per the Wisconsin WIC Program's *Operations Manual*, section 10.41, procedure E, which states "Information may be released in a way that protects the identity of the individuals" (section.10.41, p. 9) (Wisconsin WIC Program, 1996).

On July 1, 2009 the researcher obtained data from the Wisconsin Division of Public Health WIC database system called ROSIE (Real-time On-line Statewide Information Environment). Only data from WIC participants who met the study inclusion criteria were acquired. The data obtained on each participant included: 1) age (months and years); 2) sex (male or female); 3) current bottle feeding status (yes or no); 4) weight

category based on weight-for-height and age (underweight, normal weight, overweight, and obese); and 4) bottle weaning status ( $\geq 14$  months or  $< 14$  months).

The Wisconsin WIC Program *Operations Manual* dictates that all weight measurements for children 24 months or more are completed on an adult scale using a floor-model beam scale or a high quality electronic/digital scale and placed on a level, uncarpeted surface. All WIC staff followed measurement standards when obtaining weight per section 3.12, of the *Operations Manual* for study participants.

The study participant's weight category was obtained by WIC staff by following section 3.14 of the *Operations Manual*. BMI-for-Age is used to assess growth of children age 2 years and older whose stature was measured. Stature was measured using a permanent-mount stature measurement board. Satellite clinics use a portable standardized stadiometer to obtain heights. The equation in Figure 3 is then used by ROSIE, a computer database, to determine BMI-for-Age.

$$\text{weight (lbs)} / (\text{height (inches)} \times \text{height (inches)}) \times 703 = \text{BMI}$$

Figure 3. Equation Used by ROSIE to Determine Body Mass Index-for-Age

Each study participant's date of birth, gender, current bottle use, and age off bottle was documented using the participant's guardian/caretaker self report. This data was entered into ROSIE by trained WIC staff. In Portage County, WI there were a total of three professional staff that took measurements and three trained support staff who entered the study participant data into ROSIE. The three professional staff included a Bachelor of Science Nutritionist, Registered Dietetic Technician, and a Masters of Science Registered Dietitian.

## **Statistical Analysis**

All study participant data retrieved from ROSIE was coded and entered into Microsoft Excel and analyzed by Dr. R. Daniel Duquette and the Researcher. To determine if a causal relationship occurred between adiposity and prolonged bottle use, an odds ratio was calculated using Vassar College's online 2x2 Contingency Table. The odds ratio was also used to determine if there was a relationship between prolonged bottle use and gender specific BMI. The researcher chose an odds ratio because it accepts categorical or nominal data as inputs.

## **CHAPTER IV**

### **RESULTS AND DISCUSSION**

#### **Introduction**

This study was conducted to determine if prolonged baby bottle use is associated with overweight and obesity. It was hypothesized that prolonged bottle use past 14 months of age will significantly increase the risk for overweight and obesity among children 3 and 4 years of age within the Women, Infant, and Children (WIC) Program in Portage County, WI. The following is the researcher's description of the results and insights of what was learned from the study.

Data from a total of 254 WIC participants 3 and 4 years of age was collected. Study participant data was coded, entered, and analyzed in Microsoft Excel. Since the majority of the data collected was nominal an odds ratio was used to determine significance. Vassar College's online 2x2 Contingency Table was used to calculate the odds ratios. Study participant demographics were described.

#### **Study Participants**

Data obtained on June 1, 2009 from the Wisconsin Department of Health Services Real-time On-line Statewide Information Environment (ROSIE) database, on Portage County WIC enrolled 3 and 4 year olds, produced a sample of 254 participants. 130 of the participants were female, 66 of them were 3 years of age and 64 were 4 years of age. 124 of the participants were male, 58 of them were 3 years of age and 66 were 4 years of

age. The weight status of the participants ranged from underweight to obese. Fourteen of the children were underweight ( $\leq$  10th percentile), 176 were normal weight ( $>$  10th percentile), 31 were overweight ( $\geq$  85th percentile), and 33 were obese ( $\geq$  95th percentile).

Table 2. Demographic Information for Study Participants by Gender (N = 254)

Demographic Variables	Total Population	Male Population (n = 124)	Female Population (n = 130)
Mean Age in Years	3.5	3.5	3.5
Mean Age in Months	48	48	48
Age 3	125 (49%)	58 (47%)	66 (51%)
Age 4	129 (51%)	66 (53%)	64 (49%)
Gender			
Male	124 (49%)		
Female	130 (51%)		
Weight Status			
Underweight	14 (6%)	6 (5%)	8 (6%)
Normal Weight	176 (69%)	88 (71%)	88 (68%)
Overweight	31 (12%)	14 (11%)	17 (13%)
Obese	33 (13%)	16(13%)	17 (13%)
Current Bottle Use			
Weaned	250 (98%)	124 (100%)	126 (97%)
Not Weaned	4 (2%)	0	4 (3%)
Weaning Status			
Before 14 months	165 (65%)	85 (69%)	80 (62%)
At or After 14 months	89 (35%)	39 (31%)	50 (38%)

As illustrated by Table 2, of the study participants, 89 were weaned from the bottle at or after 14 months of age and 165 were weaned from the bottle before 14 months of age. Only 4.5% (4) of the 254 study participants were current bottle users. Within the study population, of those who were weaned from a bottle at or after 14 months of age

(n = 89), 8% were underweight, 54% were normal weight, 10% were overweight, and 18% were obese. Among study participants who were weaned before 14 months of age (n = 165), 4% were underweight, 74% were normal weight, 13% were overweight and 9% were obese.

Table 3. Demographic Information for Study Participants by Weaning Status (N = 254)

Demographic Variables	Total Population	Weaned $\geq$ 14 Months of Age (n = 89)	Weaned < 14 Months of Age (n = 165)
Mean Age in Years	3.5	3.5	3.5
Mean Age in Months	48	47	48
Age 3	125 (49%)	47 (53%)	77 (47%)
Age 4	129 (51%)	42 (47%)	88 (53%)
Gender			
Male	124 (49%)	39 (44%)	85 (52%)
Female	130 (51%)	50 (56%)	80 (48%)
Weight Status			
Underweight	14 (6%)	7 (8%)	7 (4%)
Normal Weight	176 (69%)	54 (61%)	122 (74%)
Overweight	31 (12%)	10 (11%)	21 (13%)
Obese	33 (13%)	18 (20%)	15 (9%)
Weight Status-Female (n = 130)		(n = 50)	(n = 80)
Underweight	8 (6%)	4 (8%)	4 (5%)
Normal Weight	88 (68%)	32 (64%)	56 (70%)
Overweight	17 (13%)	7 (14%)	10 (12.5%)
Obese	17 (13%)	7 (14%)	10 (12.5%)
Weight Status-Male (n = 124)		(n = 39)	(n = 85)
Underweight	6 (5%)	3 (8%)	3 (3%)
Normal Weight	88 (71%)	22 (56%)	66 (78%)
Overweight	14 (11%)	3 (8%)	11 (13%)
Obese	16 (13%)	11 (28%)	5 (6%)
Current Bottle Use			
Weaned	250 (98%)	85 (95.5%)	165 (100%)
Not Weaned	4 (2%)	4 (4.5%)	0 (0%)

## Results

### Null Hypothesis One

According to the first null hypothesis, prolonged bottle use past 14 months of age will not significantly increase the risk for overweight among children 3 and 4 years of age within the Women, Infants, and Children (WIC) Program in Portage County, WI. The study participants were split into four groups: 1) those who were overweight and used a bottle at or after 14 months of age ( $n = 10$ ); 2) those who were overweight and were weaned from the bottle before 14 months of age ( $n = 21$ ); 3) those who were normal and underweight and were weaned from the bottle before 14 months of age ( $n = 129$ ); and 4) those who were normal and underweight and had used a bottle at or after 14 months of age ( $n = 61$ ). As seen in Figure 4, those who were categorized as overweight had the same bottle weaning patterns as those who were of normal weight. Within both weight categories, 32% weaned from the bottle at or after 14 months of age and 68% weaned before 14 months of age. For this reason, the first null hypothesis failed to be rejected.

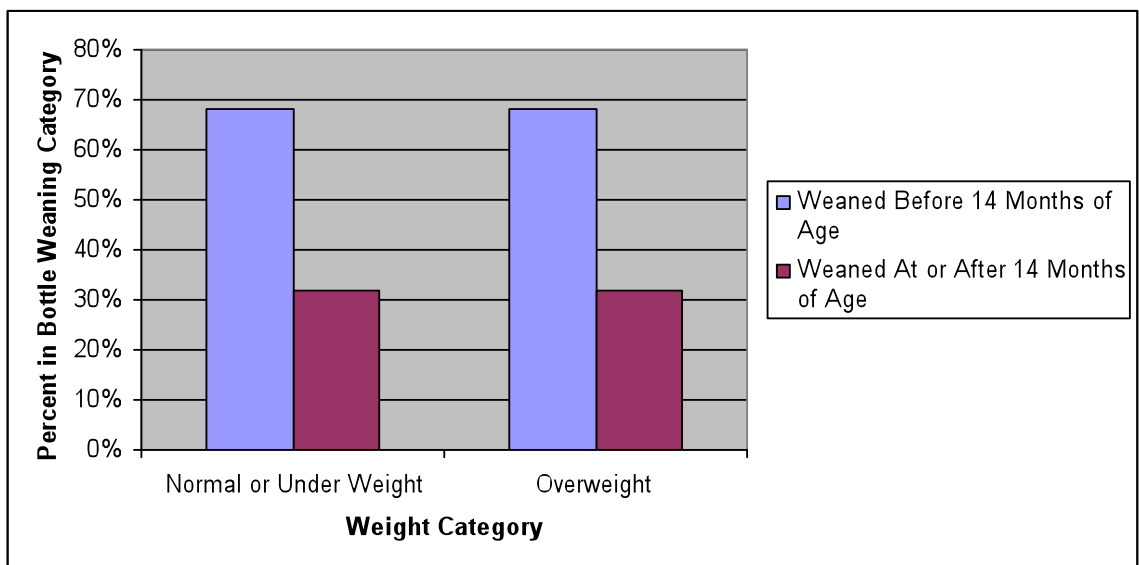


Figure 4. Comparing Differences in Weaning Status among the Normal and Underweight Study Participants with the Overweight Study Participants.

## Null Hypothesis Two

The second null hypothesis stated prolonged bottle use past 14 months of age will not significantly increase the risk for obesity among children 3 and 4 years of age within the Women, Infants, and Children (WIC) Program in Portage County, WI. Again, the study participants were split into four groups: 1) those who were obese and used a bottle at or after 14 months of age ( $n = 18$ ), 2) those who were obese and had weaned before 14 months of age ( $n = 15$ ); 3) those who were normal, underweight, and overweight and had weaned before 14 months of age ( $n = 150$ ); and 4) those who were normal, underweight, and overweight and had used a bottle at or after 14 months of age ( $n = 71$ ). Figure 5 shows that among those who were obese, 55% used or weaned from the bottle at or after 14 months of age and 45% weaned from the bottle before 14 months of age. Among those who were underweight, normal weight, and overweight, 32% used or weaned from the bottle at or after 14 months of age and 68% weaned from the bottle before 14 months of age.



Figure 5. Comparing Differences in Weaning Status among the Underweight, Normal Weight, and Overweight Study Participants with the Obese Study Participants.

An odds ratio was used to determine if there was a significant association between bottle use and weaning at or past 14 months of age and obesity. The results indicated a statistically significant association (OR: 2.5352, 95% CI: 1.2082-5.3195). Thus, the second null hypothesis was rejected.

### **Null Hypothesis Three**

Null hypothesis number three stated that prolonged bottle use at or after 14 months of age will not significantly increase the risk for obesity and/or overweight among females 3 and 4 years of age within the Women, Infants, and Children (WIC) Program in Portage County, WI. The study consisted of 130 female children 3 and 4 years of age. Of those children, 74% were at normal or underweight, 13% were overweight, and 13% were obese. Of the normal and underweight female children (n = 96) 62.5% were weaned before 14 months of age and 37.5% were weaned at or after 14 months of age. Within both populations of overweight (n = 17) and obese (n = 17) female children, 59% were weaned before 14 months of age and 41% were weaned at or before 14 months of age. Due to the equal proportions of weaning before, at, and after 14 months of age among the obese and overweight population, as illustrated in Figure 6, the two weight categories were grouped together for statistical analysis.

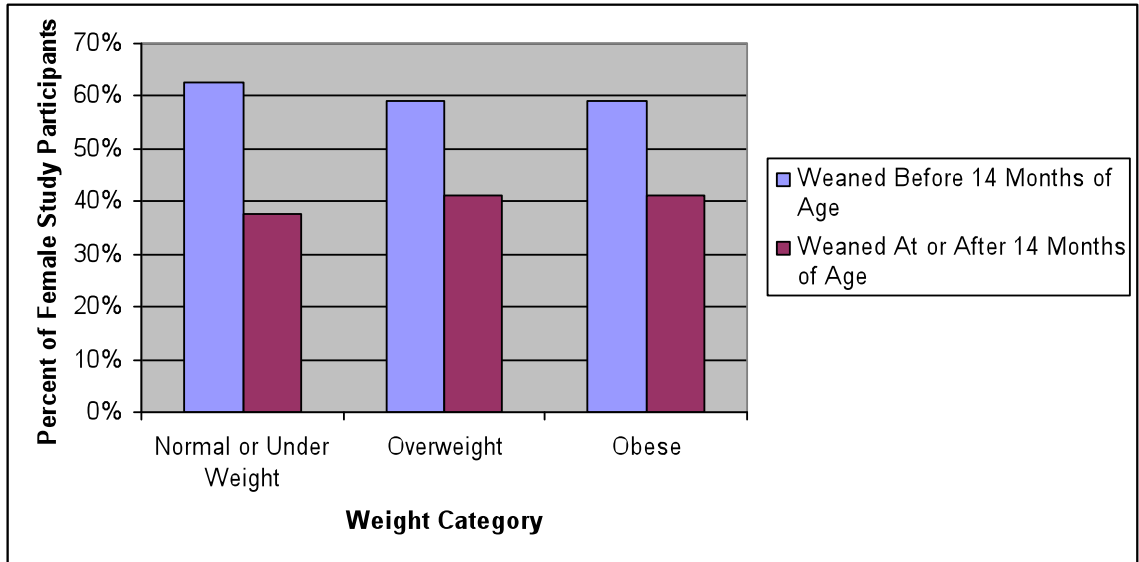


Figure 6. Comparing Differences in Weaning Status Among the Underweight and Normal Weight Female Study Participants with the Overweight and Obese Female Study Participants.

An odds ratio was used to determine if there was a significant association between obesity and overweight among female children 3 and 4 years of age and weaning at or past 14 months of age. The results did not indicate a statistically significant association (OR: 1.1667, 95% CI: 0.6811 - 1.7703). The third null hypothesis failed to be rejected.

#### Null Hypothesis Four

Null hypothesis number four stated that prolonged bottle use past 14 months of age will not significantly increase the risk for obesity and/or overweight among males 3 and 4 years of age within the Women, Infants, and Children (WIC) Program in Portage County, WI. The study consisted of 124 male children 3 and 4 years of age. Of those children, 76% were normal or underweight, 11% were overweight, and 13% were obese. Of the normal and underweight male children 73% were weaned before 14 months of age and 27% were weaned at or after 14 months of age. Within the population of overweight

male children 79% were weaned before 14 months of age and 21% were weaned at or after 14 months of age. Among the obese male children, 31% were weaned before 14 months of age and 69% were weaned at or before 14 months of age. Due to the unequal proportions of weaning before, at, and after 14 months of age among the obese and overweight population, as illustrated in Figure 7, the two weight categories were separated during statistical analysis.

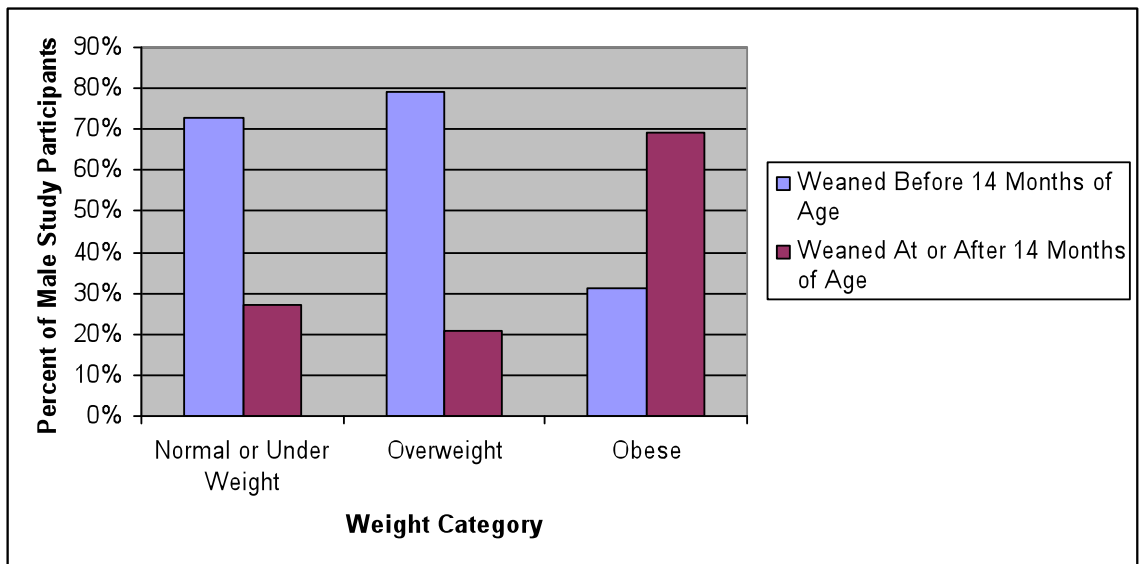


Figure 7. Comparing Differences in Weaning Status Among the Underweight and Normal Weight Male Study Participants with the Overweight and Obese Male Study Participants.

An odds ratio was used to determine if there was a significant association between obesity and overweight among male children 3 and 4 years of age and weaning at or after 14 months of age. The results did not indicate a statistically significant association (OR: 0.7527, 95% CI: 0.1939-2.9215) for overweight male children. However, the analysis did indicate a statistically significant association (OR: 6.2857, 95% CI: 2.0075-19.6814) for obese male children. For this reason, the fourth null hypothesis was rejected.

## Discussion

Infant and toddler feeding practices may be one of the most influential factors attributing to a major risk factor for obesity— caloric imbalance (CDC, 2009). Not only bottle feeding, but prolonged bottle feeding can put a child at risk for increased caloric intake (Stutcliffe, Khambalia, Westergard, Jacobson, Peer, & Parking, 2006). Although, health officials recommend bottle weaning by 12-15 months of age, studies have reported prolonged bottle use from 20%-42% at age 2 and 9%-16% at age 3 (Bonuck, Huang, Fletcher, 2009; Safer, Bryson, Agras, & Hammer, 2001; Bonuck & Kahn, 2002; Kimbro, Brooks-Gunn, & McLanahan; 2007; Katse & Gift, 1995). The researchers sample had lower rates of prolonged bottle use than have been found in previous studies; 3.2% of children 3 years of age still had caloric intake from a bottle and none of the children 4 years of age continued to use a bottle. Regardless, the researcher had a significant percentage of study participants (35%) who were not weaned from the bottle at or after 14 months of age.

The researcher did find that bottle use was significantly associated with obesity ( $\geq$  95th percentile) in males, but not with overweight ( $\geq$  85th percentile) or obesity ( $\geq$  95th percentile) in females. Finding prolonged bottle use had an effect on weight status among the heaviest study participants is consistent with the Institute of Medicine's (2004) observation of trends in childhood obesity where the heaviest children are getting heavier and the leanest children are staying lean (Institute of Medicine, 2004). The lack of association between prolonged bottle use and weight status in the female study population is difficult to explain. The female study population had higher rates of prolonged bottle use (38%) when compared to the male study population (31%).

However, the female study population had much lower rates of obesity among prolonged bottle users (41%) than the male study population (69%). Possible reasons for the lack of association between bottle use and weight in female children include: 1) no association between prolonged bottle use and obesity exists; 2) protective factors, unknown to the researcher and not controlled for, could exist in higher rates among the female population compared to the male population; and 3) the amount of daily caloric intake consumed among prolonged bottle users is unknown, the female study population may have consumed less calories through bottle use compared to the male study population.

Regardless, the researcher's study suggests a relationship between prolonged bottle use and obesity exists. Higher levels of obesity among prolonged bottle users is consistent with findings from other researchers (Bonuck & Kahn, 2002; Bonuck, Kahn, Schechter, 2004; Bonuck, Huang, and Fletcher, in press). This is the first study to examine gender differences in prolonged bottle use and obesity. More research is needed to confirm or deny gender differences in weight status among prolonged bottle users and to determine causation.

### **Summary**

The purpose of this study was to investigate the connection between prolonged bottle use and weight status among Women, Infants, and Children (WIC) Program enrolled participants 3 and 4 years of age in Portage County, Wisconsin. The study utilized a non-experimental quantitative causal-comparative research design. All study participant quantitative data was retrieved from ROSIE and entered into Microsoft Excel to generate measures for data analysis.

After the study data was analyzed, the researcher learned an association between prolonged bottle use and obesity existed, particularly among the male study participants. The association found among the heaviest study participants is consistent with findings from other researchers and trends among obese children (Bonuck, Huang, & Fletcher, 2009; Institute of Medicine, 2004). However there was no statistically significant association between prolonged bottle use and overweight or obesity among female study participants. The researcher feels more in-depth analysis is needed to identify the reason for the lack of association.

**CHAPTER V**  
**SUMMARY OF FINDINGS, CONCLUSIONS, AND RECOMMENDATIONS**

**Introduction**

During the past three decades, childhood obesity rates have more than doubled, leading the United States further away from the Healthy People 2010 target prevalence of 5% (CDC, 2009; Institute of Medicine, 2004). According to researchers Kim, Peterson, Scanlon, Fitzmaurice, Must, and Oken, et al. (2006) the prevalence of overweight and obesity among infants age birth to 11.9 months has increased substantially over the last two decades.

Caloric imbalance is cited as the major risk factor for obesity by the Centers for Disease Control and Prevention (CDC, 2009). Infant and toddler feeding practices may be one of the most influential factors attributing to a caloric imbalance. Research indicates feeding practices such as prolonged baby bottle use causes elevated energy intake, increasing a child's risk of overweight and obesity (Stutcliffe, Khambalia, Westergard, Jacobson, Peer, & Parking, 2006).

The purpose of this study was to investigate the connection between prolonged baby bottle use and weight status among Women, Infants, and Children (WIC) Program enrolled participants 3 and 4 years of age in Portage County, WI. This final chapter includes: 1) a summary of the study; 2) discussion of major findings, and; 3) recommendations.

## Summary of Findings

The study utilized a non-experimental quantitative causal-comparative research design. All study participant quantitative data was retrieved from Real-time On-line Statewide Information Environment (ROSIE) database and entered into Microsoft Excel to generate measures for data analysis. To determine if a causal relationship occurred between overweight/obesity and prolonged bottle use, an odds ratio was calculated. The odds ratio was also used to determine if there was a relationship between prolonged bottle use and gender specific Body Mass Index-for-Age. The findings of the study are as follows:

### **Null Hypothesis One: Prolonged bottle use past 14 months of age and overweight**

Data analysis indicated no association between prolonged bottle use and overweight among children 3 and 4 years of age enrolled in the Portage County, WI WIC program. The proportion of prolonged bottle users who were overweight was identical to underweight and normal weight children also classified as prolonged bottle users. For this reason, calculation of an odds ratio was unnecessary and the null hypothesis failed to be rejected.

### **Null Hypothesis Two: Prolonged bottle use past 14 months of age and obesity**

An association was found between prolonged bottle use and overweight among children 3 and 4 years of age enrolled in the Portage County, WI WIC Program. The proportion of prolonged bottle users was significantly higher among the obese study population. An odds ratio was used to determine if there was a significant association between bottle use and weaning at or past 14 months of age and obesity. The results

indicated a statistically significant association (OR: 2.5352, 95% CI: 1.2082-5.3195). Thus, the second null hypothesis was rejected.

**Null Hypothesis Three: Female prolonged bottle use past 14 months of age and obesity**

Among the female study population no association was found between prolonged bottle use and overweight and obesity among children 3 and 4 years of age enrolled in the Portage County, WI WIC Program. Separate analysis of the overweight and obese female study population was unnecessary as the proportions of overweight females and obese females were identical. Thus, the two weight categories were grouped together for statistical analysis. The odds ratio did not indicate a statistically significant association (OR: 1.1667, 95% CI: 0.6811-1.7703) between prolonged bottle use and overweight/obesity. The third null hypothesis failed to be rejected.

**Null Hypothesis Four: Male prolonged bottle use past 14 months of age and obesity**

Within the male study population, a strong association was found between prolonged bottle use and obesity. However, no association was found between prolonged bottle use and overweight. Separate analysis of the overweight and obese male population was necessary as the proportions of overweight males and obese males were substantially different. An odds ratio was used on each analysis. An odds ratio of 0.7527 (95% CI: 0.1939-2.9215) for overweight male children, indicated no association. However, an odds ratio of 6.2857 (95% CI: 2.0075-19.6814) for obese male children, indicated a statistically significant association. Thus, the fourth null hypothesis was rejected.

## **Conclusions**

The researcher concluded that prolonged bottle use past 14 months of age is associated with obesity and not with overweight. The association found among the heaviest study participants is consistent with findings from other researchers and documented trends among obese children (Bonuck, Huang, & Fletcher, in press; Institute of Medicine, 2004).

However, upon further analysis, the researcher uncovered that the obese male study population and not the obese female study population contributed to the association. The researcher concluded the lack of association among the female study population may be due to the following: 1) no association between prolonged bottle use and obesity exists; 2) protective factors, unknown to the researcher and not controlled for, could exist in higher rates among the female study population compared to the male study population; and 3) the amount of daily caloric intake consumed among prolonged bottle users is unknown, the female study population may have consumed less calories through bottle use compared to the male study population.

## **Recommendations**

The researcher's study suggests a relationship between prolonged bottle use and obesity exists. To date, only five studies have been published documenting research on prolonged bottle use and its association with overweight and obesity. Of those five studies, two of them found a statistically significant association and one found a nearly statistically significant association. The three studies documenting an association were all lead by the same researcher (Bonuck & Kahn, 2002; Bonuck, Kahn, Schechter, 2004; Bonuck, Huang, and Fletcher, in press). Due to the lack of diversity in investigators and

methodologies used to study prolonged bottle use in relationship to overweight and obesity, the researcher recommends additional research on the subject is needed before any conclusions can be drawn.

This is the first study to examine gender differences in prolonged bottle use and obesity. The findings of the study suggest differences existed between the male and female study population that either protected female prolonged bottle users from obesity or placed male prolonged bottle users at greater risk for obesity. The differences between the female and male study populations also may have been the effect of uncontrolled variables such as birth weight, maternal weight, maternal smoking status, physical activity levels, and caloric intake from a bottle. Thus, the researcher recommends additional research to confirm or deny gender differences in weight status among prolonged bottle users and to determine causation.

Although the association between prolonged bottle use and overweight and obesity is still uncertain, proactive measures can still be taken to reduce a child's risk. In fact, reducing a child's risk for overweight and obesity early in life is crucial, as research has shown that obesity in infancy and childhood can lead to obesity in adulthood (Baird, Fisher, Lucas, Kleijnen, Roberts, & Law, 2005; Office of the Surgeon General, 2001; Baird, Fisher, Lucas, Kleijnen, Roberts, & Law, 2005).

Researchers studying prolonged bottle use have found strong correlations with Hispanic ethnicity, socioeconomic status, less than high-school education, mother returning to work 3 months or less postpartum and urban status (NHIS, 1991; Northstone, Rogers, & Emmet, 2002; Hammer, Bryson, & Agras, 1999). Further education targeted at mothers residing within these populations on the health implications of prolonged bottle

use is warranted and necessary. In addition, research documents that dental visits are an effective means to decrease prolonged bottle use (Kaste & Gift, 1997). Educating future and practicing dentists and hygienists on their role in reducing not only dental caries, but obesity among toddlers, may help reduce prolonged bottle use duration putting children at less risk for overweight and obesity.

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