THE EFFECTS OF MATERNAL EDUCATION ON PREGNANCY KNOWLEDGE AND BEHAVIORS USING THE PREGNANCY RISK ASSESSMENT MONITORING SYSTEM DATA

by

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ABSTRACT

BARBARA LAPOINTE FERGUSON. The effects of educational attainment on pregnancy knowledge and behaviors using the Pregnancy Risk Assessment Monitoring System (PRAMS) Data.
(Under the direction of DRS. A. SUZANNE BOYD and JENNIFER TROYER)

Background: It is estimated that 90 million Americans have trouble understanding and using health information. Specific Aims: Examine the: (1) association between education and the health knowledge and behaviors of maternal women in two different time periods (1997-1999 and 2006, 2008, & 2009) and (2) trends in maternal health knowledge and behaviors, separately, stratified by education. Study Design: A retrospective design was conducted, using the North Carolina PRAMS data. Analyses: Multiple logistic regression models estimated the likelihood that (1) education would affect behavior and knowledge in the areas of the folic acid consumption, breastfeeding, and infant sleep position and (2) there would be a positive trend in these three areas. Results: Women with <12th grade education were less likely to (1) have knowledge of folic acid (OR=0.64, 95% CI=0.48-0.84) and (2) use the correct infant sleep position (OR=0.54, 95% CI=0.34-0.85) when compared with high school graduates. The trend found that women with <12th grade education in the latter time period were more likely to have knowledge about folic acid. Women of all educational backgrounds were more likely to breastfeed in the latter phase compared to earlier phase and women with between 9th and 15th grades education were more likely to place their infant to sleep on his/her back. Significance: The results suggest that improvements over time are occurring in some key maternal health areas, such as folic acid knowledge, breastfeeding, and correct infant sleep position.

DEDICATION

"We must remember that education is not enough. Intelligence plus character-that is the goal of true education. The complete education gives one not only power of concentration, but worthy objectives on which to concentrate."
Dr. Martin Luther King, Jr as a Senior at Morehouse College, 1948

Apply your heart to instruction
and your ears to words of knowledge.
Proverbs 23:12

In memory of those close to me who passed away while I was on this journey:

Ann Donahue LaPointe, my mother, the most giving person I have ever known.
Frank Joseph LaPointe, my father, the smartest person I have ever known.
Bennett, my dog, the most precious and loving animal I have ever known.

My family has been with me this entire journey; I thank you all from the bottom of my heart. Tom, you have always supported me in my work and school undertakings even when it made life more difficult for you, thank you. Alison, Meredith, Russ, and Lauren, your prayers and encouragement helped out far more than you can ever imagine, thank you. Lilly, without knowing it, you kept me moving forward; time spent with you was a time away to laugh and love life, thank you. God has also been with me and directed me and has a plan for me, thank you Lord. I love you all tremendously.

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CHAPTER 1: INTRODUCTION

1.1 Literacy

Literacy is defined by the National Assessment of Adult Literacy (NAAL) (2012) as “an individual’s ability to use printed and written information to function in society, to achieve one's goals, and to develop one's knowledge and potential.” This is the most widely used definition in the literature. Literacy is a complex concept that encompasses a set of skills, which includes the ability to read, write, and comprehend all types of information, and is one of the top goals of the education system (Literacy Statistics, 2011).

In 1993, the nation’s most comprehensive measure of adult literacy was published by the National Center for Education Statistics (Kirsch , Jungeblut, Jenkins, & Kolstad, 2002). Specifically, the National Adult Literacy Survey (NALS) complied information from over 13,000 randomly sampled adults and provided comprehensive information on U.S. literacy rates. In 2003, this information was updated with a sample of over 19,000 individuals (Kutner, Greenberg, Jin, Paulsen, & White, 2006). The results from the first survey in 1993 found that low literacy affected as many as 90 million adults (Kirsch et al.). This survey found that approximately 40 million adults had very basic reading and writing skills and were unable to perform simple tasks, while another 50 million adults were in the second lowest level of literacy. The 2003 survey confirmed these findings.

These statistics clearly pointed out that low literacy is a major problem among adults in the United States.

There are numerous consequences associated with low literacy. In 2003, 43% of U. S. adults with low literacy were classified as living in poverty, leading to an increased reliance on government assistance (Kutner et al., 2006). Many previous studies have indicated that low literacy is associated with low-income status in the United States (Howard, 2004; Kirsch et al., 2002). It stands to reason that without a proper education, individuals will be blocked from higher paying jobs. It has been estimated that each additional year of schooling increases a woman's income by 10 to 20 percent, indicating a very strong relationship between these two variables (Filmer, 1999).

Specific to women, the consequences of lower literacy perpetuate within the family unit (Literacy Statistics, 2011). Infants and children of mothers with low literacy fare worse in society as a result of their mothers' lack of knowledge and comprehension skills (Wadsworth & Butterworth, 2006). For instance, research indicates that these women are more likely to have an unplanned pregnancy, and often present for prenatal care later than other women (Endres & Sharp, 2004). They are also less likely to have discussed becoming pregnant with a health provider than women with adequate literacy skills. Moreover, if a woman has a chronic disease that will affect a pregnancy, such as diabetes, she is less likely to have discussed becoming pregnant with the doctor who manages her diabetes or with an obstetrician (Endres & Sharp).

A mother's literacy level also has a major influence on her child's success in school (Kutner et al., 2006). Low literacy begets low literacy, but when a mother raises her literacy skills, by attending literacy programs or by some other means, her children are less likely to drop out of school. Literate parents are more likely to place a higher importance on educational opportunities for their children and promote life-long learning skills (Literacy Statistics, 2011).

There does not seem to be an ‘easy fix’ solution connected to the problem of low literacy. While the U.S. is currently one of the most well-educated countries in the world, it has a large and ever-growing group of people at the lower education levels (National Center for Education Statistics, 2012). The National Commission of Adult Literacy, in their 2008 *Reach Higher, America* publication, reported that Americans actually are becoming less educated (National Center for Education Statistics). Today, more than ever before, younger adults are less educated than the previous generation (National Center for Education Statistics). One in three of our nation's youth do not graduate from high school. The American dream of each succeeding generation having more education than the previous generation is no longer being realized.

1.2 Educational Attainment: A Proxy for Literacy

Research has consistently linked low literacy to educational attainment (Cho, Plunkett, Wolf, Simon, & Grobman, 2007; Howard, 2004; Kirsch, Jugeblut, Jenkins, & Kilstad, 2002; Kutner et al., 2006; Wilson et al., 2006). Educational attainment is defined as the highest level of education that an individual has completed (U.S. Census Bureau, 2012), while literacy relates to a set of skills that are, for the most part, acquired in school (Darcovich, 2000). Literacy is, defined in this paper as, the knowledge people have acquired through the years of formal education (i.e., educational attainment). Please see Table 1 for a complete listing of defined concepts. For the purposes of this dissertation, educational attainment will be used as the proxy for literacy.

An association between education attainment and literacy skills is evident worldwide as well as in the U.S. (Darcovich, 2000). In all countries adults with higher levels of education have, on the whole, higher average literacy scores. On the national front, Kaestle, Campbell, Finn, Johnson, and Mikulecky (2001), using data from the National Adult Literacy Survey, found a positive relationship between educational attainment and literacy skills. In their study, formal education correlated strongly with higher literacy abilities at all levels and among all groups of gender, ethnicity, race, and age.

However, literacy and educational attainment are not always correlated (Kirsch et al., 2002; Wilson et al., 2006) because individuals can gain reading and comprehension skills after leaving school or can forget some learned skills through non-use. If individuals do not practice their literacy skills after their formal years of schooling, educational attainment will be higher than actual literacy skills. On the other hand, individuals who acquire skills through life experiences will have higher literacy skills than educational attainment would suggest. In these instances, defining literacy by educational attainment is not a perfect correlation.

But, accessing the types and varied learning opportunities necessary to become literate is difficult outside the walls of a formal school setting (Darcovich, 2000). Thus, literacy skills are commonly calculated in terms of a grade level or educational attainment (Doak, Doak, & Root, 1996). Research suggests that adults who earned a high school diploma or equivalent are far less likely to score in the lowest literacy levels (Kirsch et al., 2002). Although not a perfect substitute of skill, “using educational attainment as a proxy of literacy is in theory an acceptable approach, since one of the purposes of education is the development of skills and knowledge" (Somers, 2005, p. 3).

1.3 Health Literacy

Low literacy is a significant health concern as it has a direct bearing on the way patients seek and receive care concerning their health and well-being (Nielsen-Bohlman, Panzer, & Kindig, 2004). Low literacy is a major barrier to healthcare when it negatively affects patients as they try to interact with the health system. Many educational skills such as reading, writing, numeracy, and problem solving, are necessary when making health decisions. The manner in which all these skills affect one's health is known as health literacy. Health literacy is a complex topic with numerous and varied definitions attributed to it. This term encompasses how well individuals understand what they need to know to manage their lifestyle for optimal health (Nielsen-Bohlman et al.). The American Medical Association (AMA, 2012) defines health literacy as "the ability to obtain, process and understand basic health information and services needed to make appropriate health decisions and follow instructions for treatment."

When people do not have adequate literacy skills they frequently encounter difficulties carrying out many health-related tasks that others complete effortlessly (Wallace, 2006). Individuals with low literacy are less likely to know how to fully understand the directions related to their health or follow a plan of care than those with adequate literacy (Wilson et al., 2006). The results of low health literacy include increased hospitalizations (Baker et al., 2002); poorer understanding of chronic disease management (DeWalt, Berkman, Sheridan, Lohr, & Pignone, 2004; Gazmararian, Williams, Peel, & Baker, 2003; Williams, Baker, Honig, Lee, & Nowlan, 1998;

Williams, Baker, Parker, & Nurss, 1998); and under utilization of preventive services (Scott, Gazmararian, Williams, & Baker, 2002). Low literacy is also a major deterrent because it impedes the health system from operating at its most efficient level, since it is often difficult for healthcare providers to detect. For example, when asked to rate their patients' literacy skills, one study found that 63 physicians were not able to identify those with low literacy (Seligman et al., 2005).

Exacerbating the problem, healthcare providers seldom receive education or practice opportunities to develop skills to identify those with low health literacy, or to improve their health literacy (Nielsen-Bohlman et al., 2004). In fact, it is estimated that one-third of healthcare professionals are unaware that health literacy has a negative impact on patient care (Nielsen-Bohlman et al.). Physicians rarely consider literacy when talking with their patients (Powell & Kripalani, 2005). For instance, in one study fewer than 10% of patients (n=182) reading below a 6^{th} grade level were identified as having a literacy problem by their healthcare provider (Bass Wilson, Griffith, & Barnett, 2002). Health literacy acts as a barrier to healthcare especially for patients who have trouble understanding information.

1.4 Historical Perspective of Health Literacy.

It was in 1998 that the AMA (2012) publicly announced health literacy's negative impact on health outcomes. That same year the World Health Organization (WHO) (Nutbeam, 1998) also came out with their definition of health literacy. The WHO defines health literacy similarly to the AMA, as "the cognitive and social skills which determine the motivation and ability of individuals to gain access to, understand and use information in ways which promote and maintain good health." (Refer to Table 1).

Since this attention to health literacy almost 15 years ago, increasingly there has been more publicity and information available to healthcare providers designed to narrow the gap between health literacy levels. Changes in healthcare that have affected those with low literacy have mainly been in three areas: (1) simplifying complex information, (2) reducing the reading level of written health educational materials, and (3) developing ways to assist patients to understand health information more easily. Each will be briefly examined.

Simplifying complex information. Complex health information acts as a barrier to healthcare for low-literate patients and can also be a hindrance to those with adequate literacy. This is especially true when trying to learn new medical terminology that is hard to pronounce and understand. Early research, involving 2,659 participants, found that those with low-literate skills could not accurately name and report information about their medications (Williams et al., 1995). Additionally, in focus groups conducted by Baker et al. (1996) low-literate participants (n=64) stated they avoided the healthcare system because healthcare providers seemed irritated when they could not easily grasp new information or had trouble filling out forms.

Reducing the reading level of written health educational materials. The research literature consistently shows not only is health information far too complex for people with low literacy, but the written materials used to augment the clinic visit are far more complex than the average reading ability of adults (Nielsen-Bohlman et al., 2004). The general population reads between 6^{th}-10^{th} grade levels, yet health materials are often written at a much higher grade level (Nielsen-Bohlman et al.). For example, Jacobson, Morton, Offutt, Shevlin, and Ray (1999) found that low health literacy participants did not understand materials written above a 5th grade level in a study involving 433 patients seen in a primary care facility. Research evaluating 74 American Academy of Pediatrics patient education brochures found that over half of the brochures were written at an 8th grade or above reading level (Freda, 2005). Results from a study evaluating obstetrical and gynecological pamphlets, found that low-literate women became easily frustrated by educational materials they could not comprehend (Freda, Damus, & Merkatz, 1999). Another study, concerning 61 first time mothers found low-literate mothers need simple health educational materials, in order to encourage healthy habits (Kaufman, Skipper, Small, Terry, & McGrew, 2001).

Developing ways to assist patients to understand health information more easily. Some early, common practices developed to educate patients encouraged healthcare providers to speak plainly, using no medical terminology, and also to use a combination of written materials (6th grade level or below), videotapes, picture brochures, and demonstrations (Doak et al., 1996). Along with these aids, two teaching programs, the ‘Teach Back Method’ (Pfizer Clear Health Communication Initiative, 2006) and ‘Ask Me 3’ (Partnership for Clear Health Communication, 2006) were initiated in 2006. The ‘Teach Back Method’ encourages healthcare providers to ask patients to repeat the important parts of a clinic visit as a means to check patient understanding. The ‘Ask Me 3’ program teaches patients how to communicate more effectively with their healthcare provider by learning to ask pertinent questions related to their health. The key to the success of these initiatives is to ensure healthcare providers are aware of the negative effects of health literacy, are properly trained to make appropriate changes, and are motivated to make these changes in their primary care facilities.

Two major publications, *Health People 2010* (U.S. Department of Health and Human Services, USDHHS, 2000) and *Health Literacy: A Prescription to End Confusion* (Nielsen-Bohlman et al., 2004) published by the Institute of Medicine (IOM) brought goals and new knowledge to this area of literacy in 2000 and 2004, respectively. *Healthy People 2010*, the United States disease prevention initiative for that decade, identified communication as a major health objective. Health literacy also garnered the attention of healthcare providers with the IOM's major report that examined the knowledge of health literacy. This publication also brought increased awareness of this phenomenon, and gave an action plan to achieve a health-literate society.

1.5 Present-Day Perspective of Health Literacy

The latest government report finds that low health literacy affects 9 out of 10 people (USDHHS, 2010a). *Healthy People 2020*, the newest set of government goals, includes presenting health information in plain language that is understandable to the majority of the population (USDHHS, 2010b). These objectives include both oral and written forms of communication and call for measurements to be connected to health outcomes so the effectiveness of present interventions can be determined. Presently, the health literacy interventions are still primarily centered on effective patient communication, comprehensive educational techniques, and simplified written health materials. The focus of health literacy at the provider level is mainly to present information clearly to assist *all* patients since rarely do healthcare providers assess patients' literacy or level of understanding (Paasche-Orlow & Wolf, 2007).

One intervention that is not currently utilized by healthcare providers is measuring patients' level of health literacy. This practice remains controversial. Health literacy experts and healthcare providers frequently are concerned that assessing patient literacy will infringe on patients' comfort level and privacy (Paasche-Orlow & Wolf, 2007). They fear a health literacy assessment will alienate patients who already face major barriers to healthcare. Even though the few studies completed on patients' acceptance of health literacy testing found favorable results (Ferguson, Lowman, & DeWalt, 2011; Johnson & Weiss, 2008; Ryan et al., 2008; Seligman et al., 2005), there is still a widespread belief that this direct measurement may shame or embarrass patients (Paasche-Orlow & Wolf). However, it is possible that assessing patients' health literacy will give healthcare providers useful information and assist them in identifying patients who do not readily understand health information. Until such time that measuring health literacy is more widely accepted, obtaining information on patient educational attainment can give valuable information and serve as an adequate proxy.

But, if healthcare providers want to measure their patients' health literacy, there are three widely accepted assessments available: (1) the Rapid Estimate of Adult Literacy in Medicine (REALM) (Davis et al., 1996); (2) the Test of Functional Health Literacy in Adults (TOFHLA) (Nurss, Parker, Williams & Baker, 1995); and (3) the Newest Vital Sign (NVS) (Weiss et al., 2005). Clinic settings vary widely in how they are set-up to manage patient care and each of these tests is unique, giving healthcare providers choices to meet the needs and constraints of their own particular clinic settings and populations. By assessing a patient's health literacy, healthcare providers may be better equipped to match the health information to the patient's level of understanding; thus, possibly leading to better understanding and subsequently better health behavior outcomes.

The present day perspective is that patients with lower literacy levels are less likely to understand written and spoken health information needed for self-care (Nielsen-Bohlman et al., 2004). The problem lies within the health system, even though this problem originates elsewhere, the health system is the place that must overcome these deficits. Better health outcomes for patients with low health literacy are called for while holding costs to a minimum. A health literacy framework is introduced next and presents the known factors that affect health literacy.

1.6 Health Literacy Framework

The framework that guided this study is presented by the IOM (Nielsen-Bohlman et al., 2004). Figure 1 depicts the health literacy framework with the proposed research variables bolded and embedded in the model. It is not a causal model; instead, it places literacy (with educational attainment as a proxy for literacy) as the basis for health literacy and illustrates the connection between individuals and health contexts on health literacy. Health contexts are defined as a wide range of environments that affect an individual's health knowledge (Nielsen-Bohlman et al.). The health contexts for the present study are identified as socioeconomic factors (i.e., age, marital status, parity, income, non-Medicaid insurance, Medicaid, race, and ethnicity); psychological factors (i.e., planned pregnancy, prenatal stress, postpartum depression); and birth characteristics (i.e., neonatal intensive care use, multiple births).

In this model the health contexts, health literacy, and individuals are equally dependent upon literacy. In turn, health outcomes are dependent upon the health contexts, health literacy, and individuals. Health literacy, besides being affected by literacy, is also influenced by the health contexts and individuals, which are also influenced by literacy.

These components all contribute to health literacy, which then outlines the health outcomes.

1.7 Problem Statement

The purpose of this study was twofold, (1) to compare educational levels in two different time periods and (2) to study the trend regarding the knowledge and behaviors of three health concerns (i.e., folic acid consumption, breastfeeding, and infant sleep position) for maternal women of varying educational levels (i.e., ≤ 8th grade, 9th-11th grade, 12th grade, 13th -15th grade, and ≥ 16th grade), utilizing six years of data from the NC PRAMS survey. PRAMS divides these six years of data into two different Phases; Phase 3 include the years, 1997,1998, and 1999, while Phase 5 includes the latter years of 2005, 2007, and 2008. The research findings provide statistical facts about the knowledge and behaviors of pregnant women and provide a time assessment, comparing when health literacy was first highlighted as a health problem to current-day.

Although not a causal study, the present trend study is an attempt to fill a gap in the current knowledge base of health literacy. Specifically, the present study provides new information concerning the knowledge and behaviors of three important health topics for maternal women and their infants. Educational attainment is used as a basic proxy for health literacy. Health literacy experts and healthcare providers need a plethora of information on the current state of health literacy in order to reliably assist those with educational deficits.

The AMA (2012) and WHO (Nutbeam, 1998) have publicized the need for all healthcare providers to become aware of the pervasiveness of low health literacy and to take steps to assist patients with the health information given patients, both verbally and in writing. Enough time has lapsed to discern if there have been improvements in the health knowledge and behaviors of low-literate individuals since the AMA and WHO defined health literacy and publicized its frequency. This trend study addressed the important question – are their differences in the knowledge and behavior of low-literate pregnant women concerning three key aspects of fetal and infant well-being since the AMA and WHO defined health literacy and publicized its impact on the health knowledge and behaviors of patients with low literacy?

1.8 Significance of the Study

This research is significant to the domain of Health Services Research as it extends the knowledge base that currently exists in that field. The present study addresses important health outcomes and how they are associated with maternal educational backgrounds. The present study also addresses changes seen over time concerning these same health outcomes concerning maternal women of varying educational backgrounds.

Healthcare is an area that is under constant examination and inspection so that the best patient health outcomes can be achieved. Many studies have demonstrated a relationship between folic acid consumption (e.g., Amitai, Fisher, Meiraz, Baram, Tounis, & Leventhal, 2008; Baykan, Ozturk, Poyrazoglu, & Gun, 2010; Bower, Miller, Payne, & Sema, 2005; Canfield, Przybyla, Case, Ramadhani, Suarez, & Dyer, 2006), breastfeeding (e.g., Akter, & Rahman, 2010; Al-Sahab, Lanes, Feldman, & Tamim, 2010; Aryal , 2007; Barria, Santander, & Victoriano, 2008; Bernardi, Jordao, & Filho, 2009), infant sleep position (e.g., Amitai, Fisher, Meiraz, Baram, Tounis, & Leventhal, 2008; Baykan, Ozturk, Poyrazoglu, & Gun, 2010; Bower, Miller, Payne, & Sema, 2005; Canfield, Przybyla, Case, Ramadhani, Suarez, & Dyer, 2006), and maternal education, but other studies have found conflicting findings. This denotes areas where further analyses are needed. Before changes in this area of healthcare can occur, a clear picture of how maternal women are affected by their education levels is important. Discussing the concept of health literacy would not be complete without fully examining the closely related construct of educational attainment.

The maternal health knowledge and behavior outcomes that were independently identified and analyzed for the present research are folic acid consumption, breastfeeding, and correct infant sleep position. Although not a causal design, the present study attempts to provide new information concerning these three important topics for maternal women and their infants, independent of each other. The trend analyses address the changes in the health knowledge and behaviors of women of varying education levels over time. These specific areas of health knowledge and behaviors, folic acid consumption, breastfeeding, and correct infant sleep position are grouped together for this study because they are important to birth outcomes and also because the goals of the *Healthy People 2020* have not been reached in any of these three areas.

1.9 Specific Aims of Research and Research Questions

The specific aims of this study were to: (1) examine the association between educational attainment and the health knowledge and behaviors of pregnant women in two different time periods (Phase 3: 1997-1998-1999 and Phase 5: 2005-2007-2008), both with and without covariates and (2) examine the trend from Phase 3 to Phase 5 in health knowledge and behaviors of pregnant women for women with varying educational attainment levels, both with and without covariates. The research questions connected to these specific aims are: (1) what is the association between education and the health knowledge and behaviors of pregnant women in the two different phases? and (2) what is the trend from Phase 3 to Phase 5 in the health knowledge and behaviors of pregnant women of varying educations? These aims and research questions were investigated retrospectively, using data from the North Carolina Pregnancy Risk Assessment Monitoring System (PRAMS, 2012).

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

Folic acid consumption, breastfeeding, and infant sleep position are three major health concerns for pregnant women. Women who have a difficult time deciphering health information (i.e., low levels of health literacy) may struggle to understand the educational information or health care instructions related to these important topics. Even though it may seem that such materials are being presented in a straightforward and relatively easy-to-follow manner, their interpretation may be much more difficult for women with low literacy levels.

The objective of this review was to identify the current research on women's knowledge and behavior of folic acid, breastfeeding, and infant sleep position as related to their health literacy. As noted in Chapter 1, health literacy is defined as "the ability to obtain, process and understand basic health information and services needed to make appropriate health decisions and follow instructions for treatment" (NAAL, 2012).

Two main questions guided this literature review. First, what is the present state of the health literacy knowledge of maternal women concerning folic acid, breastfeeding, and infant sleep position? Second, how is health literacy measured and defined in research? Are correlations between health literacy, literacy, education, and educational attainment included as part of the analyses? The findings for the first question are examined for each variable separately.

A thorough review of folic acid, breastfeeding, and infant sleep position research pertaining to health literacy, literacy, education, and educational attainment was completed. The major databases of PubMed, CINAHL, Science Direct, and Health Source: Nursing/Academic Edition were comprehensively searched. In addition to these databases, this methodical search included Google Scholar, using the same search terms and a comprehensive look at the bibliographies of all manuscripts included in this study. The limits used for this search included: (1) an adult female population, 19-45 years of age, (2) published in English, and (3) included quantitative and qualitative analyses.

2.2 Folic Acid Consumption

Women of childbearing age who consume 400 micrograms of folic acid daily can reduce the risk of infant birth defects (Centers for Disease Control and Prevention, [CDC], 2012a). Folic acid (vitamin B9), also called folate, must be taken prior to conception and at the very earliest stage of a pregnancy in order to protect the neonate's spinal column and brain. Since about 50% of pregnancies are unplanned, it is imperative that all women of childbearing years understand the need for this vitamin. This simple procedure, one pill a day, can reduce the risk of an infant born with a neural tube defect by as much as 70% (CDC, 2012a).

The CDC (2012a) reports some gains in women's knowledge and consumption of folic acid. In 2005, only 7% of women reported knowing that folic acid should be taken before a pregnancy and by 2007, this percentage almost doubled, increasing to 12%. As these statistics point out, more education for women of child bearing years is needed before the majority of women understand the importance of folic acid to reduce the risk of infant birth defects. What is not clearly stated in these percentages is how one's educational attainment level affects women's folic acid knowledge and behavior.

Taken together, many studies report a significant and positive relationship between one's literacy level and folic acid knowledge and behavior. As educational levels increased, so did the knowledge of the importance of folic acid consumption for a pregnancy (e.g., Amitai, Fisher, Meiraz, Baram, Tounis, & Leventhal, 2008; Baykan, Ozturk, Poyrazoglu, & Gun, 2010; Bower, Miller, Payne, & Sema, 2005; Canfield, Przybyla, Case, Ramadhani, Suarez, & Dyer, 2006; Fauzi, McKenna, Yusoff, & Rahman, 2009; Goldberg et al., 2006; Li, Ren, Zhang, Liu, & li, 2007; Molster, Samanek, Boer, & O'Leary, 2009; Rasmussen, 2010; Tinker, Cogswell, Devine, & Bery, 2010; Watson, Brown, & Davey, 2006). Examples of these study findings follow. (For a complete listing of all folic acid studies reviewed, please see Table 2). Van Eijsden et al.'s (2006) study, with over 12,000 participants, found that women in the highest educational level were over five times more likely to have the knowledge of the importance of folic acid compared to women in the lowest educational group. Amitai et al. (2008) also studied folic acid knowledge and found that not even 50% of the women with a college education knew to take folic acid preconceptually. Even more alarming though, in their study of over 5,000 women interviewed at different years (i.e., 2000, 2002, and 2005), not even 14% of the women with less than a 12th grade education had this knowledge. Sharp et al. (2009) found similar results involving 250 women. In their study, participants with an education beyond high school were approximately nine times more likely to be aware of folic acid than those with less than a high school education.

Having enough participants represented in the low educational categories for health literacy assessment can be problematic for researchers. For example, one limitation of the Sharp et al. (2009) study noted above was that only 6% of the 250 participants were in the low literacy category, while 66% of participants had some college education. However, this review did identify a few studies with a larger sample size of women in the low educational attainment levels, but most studies included a small percentage of low literate women, similar to the Sharp et al. study. For example, both the Baykan et al. (2010) and Li et al. (2007) studies are unusual in the breakdown of their participants. In Baykan et al.'s study, the sample size of women with less than a high school education was very high (n=699) and much higher than the two other education levels (i.e., high school graduate, n=259 and university graduate, n=125). Li et al.'s study also had an unusually high number of women in the low education category. A total of 410 participants had less than a high school education, compared to only 53 participants with a high school education and 13 women with junior college or better education. Both studies suggest there is a positive and significant relationship to folic acid knowledge and women's education.

Another important factor in the prevention of birth defects focused on when folic acid is consumed. The findings from these studies are important since a woman needs adequate levels of folic acid at the time of conception. Al-Hossani et al. (2010) found that only a small number of the women (n=277) of all educational backgrounds took folic acid prior to pregnancy. Brough et al.'s (2009) study of periconception folic acid supplement use in a socially deprived, ethnically diverse population involving 402 women, found that women with higher education started taking folic acid earlier than their counterparts with less education.

This positive relationship between educational level and folic acid consumption appeared in other studies as well. Using six years of retrospective data, de Walle & van den Berg (2002) found that pregnant women with low education were less likely to take folic acid supplements as recommended. Similarly, Sukchan et al. (2010) found that women with low educational levels were 1.5 to 3 times more likely to have insufficient intake of folic acid in their study involving 400 women.

However, not all studies reported this positive relationship between educational level and folic acid knowledge and behavior (Coonrod, Bruce, Malcolm, Drachman, & Frey, 2009; Dawson, Pham, & Hunter, 2001; Hassan & Al-Kharusi, 2008; Timmermans et al., 2008). Coonrod et al. found that awareness of the benefits of folic acid in pregnancy decreased with younger age, but not low educational levels in their study of 305 women. In an earlier study completed by Hassan & Al-Kharusi, similarly no association was found between knowledge of folic acid and education among 300 women. Furthermore, using data collected from almost 7,000 women in a world-based study, Timmermans et al. found maternal education was statistically significant for certain populations (i.e., Dutch and Turkish), but not for other populations (i.e., Moroccan, Suriname or Antilles, groupings of other western and other non western populations) concerning women's knowledge of folic acid. Dawson et al. also found that out of a total of 342 participants, women's education did not correlate with folic acid consumption. Upon further examination, they found that their participants who did not take folic acid believed that their dietary intake was sufficient and supplementation was not necessary.

Altogether, the research findings on folic acid knowledge and consumption among women of childbearing age have reported some conflicting findings; however, the majority of studies found a positive association between these two concepts. The research outcomes, as a whole, find that maternal women with low educational status have more trouble understanding the information about folic acid, than those with higher education, which, in turn, will affect their usage (e.g., Amitai, Fisher, Meiraz, Baram, Tounis, & Leventhal, 2008; Baykan, Ozturk, Poyrazoglu, & Gun, 2010; Bower, Miller, Payne, & Sema, 2005; Canfield, Przybyla, Case, Ramadhani, Suarez, & Dyer, 2006; Fauzi, McKenna, Yusoff, & Rahman, 2009; Goldberg et al., 2006).

2.3 Breastfeeding

Pregnant women need to know the importance of breastfeeding and for those who elect to breastfeed, develop a breastfeeding plan before the birth of her infant. Breastfeeding has benefits for both the infant and for the mother (American Academy of Pediatrics [AAP], 2005a). The present study assesses women's knowledge and behavior of breastfeeding associated with her educational level. Even though recommendations urge women to breastfeed for at least 6 months, any length of time a mother breastfeeds has health benefits (March of Dimes, 2012). Initiating breastfeeding takes knowledge and forethought on the part of a woman while she is pregnant and drives other decisions, such as exclusivity and duration of breastfeeding.

Since 2005, the AAP has recommended that all mothers breastfeed exclusively the first six months and continue breastfeeding for at least the first year of their infants' life and thereafter, for as long as mutually desired. Both the American Dietetic Association (ADA) (Dobson & Murtaugh, 2004) and the World Health Organization

(WHO, 2007) have endorsed similar recommendations to the AAP. At first glance, U.S. statistics associated with breastfeeding are positive. The CDC (2012b) reported that in 2011, 74.6% of U.S. women initiated breastfeeding, which is getting close to the *Healthy People 2020* goal of 75% (USDHHS, 2010b). But, when this information is broken down by states, many individual states (i.e., Alabama, Kentucky, Louisiana, Mississippi, and West Virginia) reported fewer than 60% of mothers initiating breastfeeding in the same year. Pertinent to the present study, the latest statistics for North Carolina's women initiating breastfeeding is 67%.

The decision to breastfeed may be affected by a woman's education level. There is so much new information a first-time mother must learn in a relatively short period of time related to just this one aspect of her pregnancy. Women with less education may fail to grasp all the information they need to make an informed decision about breastfeeding (Nielsen-Bohlman et al., 2004). Table 3 presents a complete list of the breastfeeding research publications reviewed here.

The majority of research reviewed found a statistically significant and positive relationship between the knowledge and behavior of breastfeeding and maternal education level. Women with the knowledge and behavior of breastfeeding had higher levels of formal education (e.g., Akter, & Rahman, 2010; Al-Sahab, Lanes, Feldman, & Tamim, 2010; Aryal , 2007; Barria, Santander, & Victoriano, 2008; Bernardi, Jordao, & Filho, 2009; Black, Godwin, & Ponka, 2008; Chaparro, & Lutter, 2010; deCastro, Engstrom, Cardoso, Damiao, Rito, & Gomes, 2009; do Nascimento, et al., 2010; Flacking, Ewald, & Starrin 2007; Hauch Fenwick, Dhaliwal, & Butt, 2011; Kristiansen, Lande, Ovrby, & Anderson, 2010; Ku & Chow, 2010).

For example, Van Rossem et al. (2009) found in their study of 2,914 participants, that the decision to breastfeed was affected by a woman's education. Mothers in the lowest educational group were less likely to breastfeed (73%), as opposed to 95.5% of the mothers in the highest educational group who breastfed. Their study is unusual in that they had a high percentage of women breastfeeding in both of these educational groupings. Yet, of the mothers who began breastfeeding, only 15% of the ones in the lowest educational group were still breastfeeding at six months as compared to 39% of mothers in the highest education group. Serving as another example, Sparud-Lundin and Wennergren (2010) found that women who initiated breastfeeding at the time of discharge from the hospital were more likely to still be breastfeeding at 2 months and 6 months if they had higher educational levels, in their study of 212 diabetic women.

Another study of interest examined breastfeeding habits of 25 mothers over an eight-year span (Flacking et al., 2007). Their findings suggest that maternal education affects both the initiation and duration of breastfeeding of pre-term and full-term infants. Comparatively, Hauch et al. (2011) found in their research involving over 2,000 participants, that women with low education who initiated breastfeeding, were more likely to discontinue breastfeeding sooner than those with more education.

Along these same lines, Krause & Lovelady (2011) and Chin et al. (2008) found comparable results. Krause and Lovelady, in their breastfeeding study as related to overweight and obese women (n=450), found that education was a statistically significant predictor of breastfeeding. Chin et al. found that when mothers (n=3,515) who had recently given birth were asked “did you ever breastfeed or pump breast milk to feed your new baby after delivery?,” that education increased as breastfeeding increased.

Mothers with a high school education were 70% more likely to breastfeed and mothers with some college were more than four times more likely to breastfeed than those with less than a high school education.

Both Krause and Lovelady (2011) and Chin et al. (2008) considered race in their respective studies. Chin and his team found no significant interaction between race (black versus white) and education as related to breastfeeding. The association was similar for white and black mothers, as education increased women in general were more likely to breastfeed. Conversely, Krause and Lovelady found statistical differences between education levels of black and white races in their research. These researchers found that higher levels of education had a significant, positive effect on black women breastfeeding their infants, but did not find this significance in white women.

Several studies found a positive relationship between initiating and exclusively breastfeeding when stratified by maternal education (e.g., Al-Sahab et al., 2010; Do Nascimento et al., 2010; Kristiansen et al., 2010; Ku & Chow, 2010; Memon et al., 2010). As two examples, Kristiansen et al. (2010) found that the odds of mothers (n=1,490) initiating and then exclusively breastfeeding their infants increased when the level of maternal education increased. Al-Sahab et al.'s (2010) research found that the maternal education was the only significant socio-economic predictor of initiating and exclusively breastfeeding. In this study of 5,615 women, the other predictors used were: age, maternal smoking, Intensive Care Unit admission, and having a home birth.

Comparatively, other studies investigating the relationship between the knowledge and the behavior of breastfeeding and maternal education presented contradictory findings within their own studies (e.g., Bernardi et al., 2009; Lessen &

Crivelli-Kovach, 2007; Mihrshahi et al., 2010; Sasaki et al., 2010; Senarath et al., 2010). Specifically, Lessen and Crivelli-Kovach found that women (n=100) in their study who had some college or graduate level education were more likely to have the intention to breastfeed during pregnancy, but no significance was found in their behavior of actually breastfeeding. This nonsignificance was present even though breast pumping, a viable option for mothers, was also analyzed in their research.

Other inconsistencies included Sasaki et al. (2010), who found that maternal education was not statistically significant with initiating and exclusively breastfeeding during the first six months of life in their study involving 312 women. While, Bernardi et al. (2009) found that women (n=2,857) with the highest level of education initiated and then exclusively breastfed for longer periods of time, but so did women in the lowest educational levels.

This review also found inconsistencies in studies pertaining to initiating and duration of breastfeeding concerning maternal education. For example, Rakhshani and Mohammadi (2009) found that the length of time the women (n=1,264) breastfed decreased among mothers of higher educational levels. Furthermore, Roudbari et al. (2009) found no significant relationship between a mother's educational level and the initiation and duration of breastfeeding in women (n=450). Tarrant et al. (2010) found in their study of 1,417 women, those mothers with low education, after initiating breastfeeding, then breastfed their infants for an average of 28.4 weeks compared to only 13.8 weeks for those with more years of formal education.

The majority of the research reviewed indicated a positive relationship between the knowledge and behavior of breastfeeding and one's educational level, a proxy for health literacy, but many research outcomes deviated from these findings. Part of the reason for these inconsistencies may stem from the fact that there are a lot of different variables that heavily influence a woman's decision to breastfeed. It is a personal choice, but when women have the knowledge and understand the health benefits of breastfeeding for their infant, as well as for themselves, the incidences of breastfeeding may increase.

2.4 Infant Sleep Position

In 1992, the AAP, (2005b) endorsed the idea that all infants be placed on their back for sleep. This recommendation was in response to research findings that the risk of sudden infant death syndrome (SIDS) is significantly reduced when infants are positioned on their back for sleep (Back to Sleep, 2010). SIDS, a leading cause of death in the first year of life, is defined as "the sudden death of any infant less than one year of age which remains unexplained after a thorough case investigation, including complete postmortem examination, review of clinical history and examination of death scene" (Willinger, James, & Catz, 1991, p. 679).

The 'Back to Sleep' campaign, which began in 1994 (AAP, 2005b), had a goal of educating mothers and infant caregivers in the proper supine (back) position for sleep in the U.S. Since that time, Americans have seen a dramatic decrease in infant deaths, yet the goals of the *Healthy People 2020* of 75.9% of infants put to sleep on their back has not been reached (USDHHS, 2010b). There are still many parents who either have not received this information or do not understand the importance of proper sleep position for infants. In 2007, only 69% of infants were put to sleep in the correct position nationwide (USDHHS, 2010b). To date, there are still far too many deaths in infants under one year of age related to SIDS each year in the U.S.; it remains a significant cause of death.

In an effort to include all recent research on infant sleep position, in the present literature review, several search terms were used. The search terms included in this analysis were: 'infant sleep,' 'back to sleep,' 'SIDS,' and 'sudden infant death syndrome.' These terms were individually coupled with the education terms described earlier in this paper as: health literacy, literacy, education, and educational attainment.

However, the two terms 'SIDS' and 'sudden infant death syndrome' were used only as a means to find all the research on the topic of 'infant sleep position' together with maternal educational status. Research in the area of SIDS-related deaths in relation to maternal and paternal educational levels exists, but that line of inquiry is beyond the scope of the present review. The relationship between maternal knowledge and subsequent behavior of correctly placing infants to sleep on their back is reported here. Table 4 presents a complete list of the research reviewed here concerning infant sleep position.

This literature review found a number of studies reporting a statistically significant relationship between the level of maternal knowledge of correct infant sleep position and maternal education (e.g., Chung, Hung, Marchi, Chavez, & Braveman, 2003; Colson, Rybin, Smith, Colton, Lister, & Corwin, 2009; Corwin, Lesko, Heeren, Vezina, Hunt, Mandell, & et al., 2003; Moon, Calabrese, & Aird, 2008; Moon, Oden, & Grady, 2004; Phares, Morrow, Lansky, Barfield, Prince, Marchi, & et al., 2004; Pickett, Luo, & Lauderdale, 2005; Pollack & Frohna, 2002). The majority of studies reviewed found that as women's educational level increased, the more likely they were to place their baby to sleep on their back.

Of particular interest, Ottolini et al. (1999) evaluated maternal education and characteristics of infant sleep position (n=348) and found this positive relationship between education and correct infant sleep position. That is, the authors found that maternal education was associated with placing infants to sleep correctly. In addition, Ottolini and associates found only one-third of physicians discussed sleep position with mothers and other caregivers when the infant was 2 and 4 months of age. This finding is important since this is the time for the highest risk of a SIDS death.

In addition, Corwin et al. (2003) comprehensively studied infant sleep position within 14,206 women of differing race/ethnicity stratified by education in the years 1995-1998. The findings are extensive since the researchers also examined the trend as well as varying infant ages. Results found that infants at one month of age did not reach the ‘Back to Sleep’ Campaign (SIDS Risk Reduction, 2012) goal of only 10% being placed in the prone (stomach) position in 1995–1996. Comparatively, by 1997–1998, this goal was reached, but only for infants of white and Asian women, who were college graduates. The use of the back sleep position for infants at one month of age was the lowest level for participants classified as black/Hispanic, who were non–college graduates. Only infants of college-educated, white mothers came close to the goal of only 10% being placed on their stomach at the three-month of age marker.

Additionally, Corwin et al. (2003) found that infants at six months of age of black/Hispanic mothers with less than a college education were markedly less likely to be placed in the correct position for sleep compared to those with higher education. The trend also was significant in this study, such that the rate of mothers not placing their infant to sleep on their back was greater than 20% among black/Hispanic women with less than a college education for both time periods.

In contrast to these studies, other studies did not find a positive relationship between infant sleep position and education (e.g., Anuntaseree et al., 2008; Kemp, Harris, & Chavez, 2006; McKinney, Holt, Cunningham, Leroux, & Starr, 2008; Lung & Su, 2011; Willinger, Ko, Hoffman, Kessler, & Corwin, 2000). In a study of over 3,000 women, women with higher education were more likely to use the wrong infant position for sleep (Anuntaseree et al). Lung and Su found in their study of 1,783 participants, that mothers with low educational levels were more likely to put their infants at six months of age to sleep in the back position. Similar outcomes were found in a study completed by McKinney et al., whose study objective was to identify factors related to the infant sleep position. Their study found no significance in education and using the back position. However, further research among the 11,000 participants, who had recently given birth, found that mothers with a high school education or less more commonly placed their infants on their side as opposed to mothers with some college education.

This review has highlighted current research on infant sleep position and its relation to maternal education. Collectively, the majority of study findings suggest that education is a factor in the knowledge and subsequent behavior of proper infant sleep position. However, there is adequate research that negates this finding. Additional research is warranted to further investigate the relationship between infant sleep position and maternal education. Studies that evaluate maternal health literacy and literacy and education are of specific need since limited research has been published on this topic. Until the goal of the *Healthy People 2020* (USDHHS, 2010b) of 75.9% of infants put to sleep on their back is reached, research is needed.

2.5 Measurements of Health Literacy Found in Research

The second objective of this literature review was to examine how literacy was measured in research studies of folic acid, breastfeeding, and infant sleep position. The search terms health literacy, literacy, education, and educational attainment were used for this analysis.

This review found vast inconsistencies when using and reporting health literacy, literacy, education, and educational attainment in research pertaining to folic acid, breastfeeding, and infant sleep position. None of the studies in this review used a standardized health literacy instrument, such as the TOFHLA (Nurss et al., 1995), REALM (Davis et al., 1996), or the NVS (Weiss et al., 2005). Overwhelmingly, the highest level of educational grade completed was the variable of choice to serve as a proxy for literacy or health literacy. Tables 2, 3, and 4 report verbatim how each research team reported, identified, defined, and categorized education. Besides this finding, others were noted as pertaining to health literacy research.

First, most studies did not adequately define, or explain the variable used as the literacy marker. As one example, Sukchan et al., in their 2010 study on folic acid, used three levels of education: (1) primary, (2) secondary, and (3) higher than secondary school, but these categories when never discussed any further by the researchers. In fact, rarely was there any discussion related to education assessed, even though it was a main area of interest. A sampling of how this variable was labeled included: maternal education level, educational attainment, or highest level of schooling attained. In general, no further explanation ensued in research studies.

When the nominal and operational definitions of the respective educational categories are not described in a study, it is much harder to compare the results between studies. For example, the term 'secondary education' can have different meanings from one country to another. Further complicating this equation is the possibility of multiple definitions for one term within one nationality. When reading international studies that use the terms ‘secondary’ and ‘tertiary education,’ without defining them, readers are left guessing the corresponding total years of formal education.

With respect to the United States, and important to the present study, many Americans may think of secondary education as 6^{th} – 8^{th} grade, but depending on their geographical location within the U.S., it may be thought of as 7^{th} – 9^{th} grade or even 6^{th} – 12^{th} grade. When reading U.S. research, which use these different terms without defining them, readers are left guessing the corresponding total years of formal education analyzed in a particular study.

Second, these educational levels varied greatly as to the *number of* categories that were used as response options or for coding purposes in each study. The category levels are presented verbatim as provided for each of the three variables of interest and can be found in Tables 2, 3, and 4. For example, some studies used only two levels representing education, such as less than 12 and greater than or equal to 12 years of education (e.g., Do Nascimento et al., 2010), or less than 8 and 8 or more years of education (e.g., Niquini, Bittencourt, Lacerda, Oliveira, & Leal, 2010). While other studies used many more levels, such as Kunwar, Faridi, Singh, Zahra, & Alizaidi, in their 2010 study they used eight educational dividers. Moon and colleagues (2004), also stratified maternal education on many levels, utilizing seven categories for educational attainment: (1) did not finish high school, (2) high school graduate, (3) some college or technical school, (4) technical school graduate, (5) 4-year college graduate, (6) postgraduate training, and (7) unknown.

Third, the manner in which education was *categorized* varied greatly between studies. It is easy to see why this would be problematic when reviewing and comparing studies, especially when trying to make conclusions related to one's literacy level and a particular health issue. To illustrate this point, in Colson et al.'s (2009) study they found that mother's (*n*=13,000) education was a factor in placing an infant in the proper sleep position. Only two levels of education categories, 'up to college' and 'college or more' were used. So, in their study, mothers were grouped together whether they had completed high school or not. Anuntaseree et al. (2008) also used only two education levels in their study on infant sleep position (*n*=2,236), but these categories were very different from the Colson et al.'s study: (1) less than and equal to 6th grade and (2) greater than a 6th grade education level. Wu et al.'s (2007) study also used only two educational levels. However, the educational marker for their study was 7th grade. Their study, involving over 1,000 interviews, found that 73% of women with education above 7th grade took folic acid, and 28% of them took it correctly, while most (83%) of the participants with less than a 7th grade education did not take folic acid. These studies, as well as others, used a far lower measurement than what is generally measured as low education.

On the other hand, Pickett et al. (2005) and Chung et al. (2003) are two examples of researchers who fully described their education variable in their study of 21,126 and 865 participants, respectively. In Picket el al.'s epidemiological study, cases of SIDS were compared to infants who survived the first year of life. The research objective was to analyze whether the ‘Back to Sleep’ campaign had reduced social class inequalities. Social class was defined in this study by the ‘mother’s highest level of educational attainment’. These researchers used five categories of educational attainment (i.e., 0-8; 9-11; 12; 13-15; 16+). Chung et al. delineated four educational categories (i.e., 8th grade or less; some high school; high school graduate or GED equivalent; some college or more) and also fully described them.

To summarize, the studies reviewed here analyze the relationship of folic acid, breastfeeding, and infant sleep position knowledge and behaviors stratified by women’s education level. Of particular note, many studies fall short of defining and operationalizing education, making comparisons between studies difficult. Although these studies provide valuable information, researchers should not assume that readers understand the divisions for education when using it for categorical data analysis. This finding is particularly apparent in the comparison of the different types of categorization reflected in the articles reviewed here. It is important for researchers to adequately identify, define, and explain each variable of interest. Researchers also need to be cognizant of how education is categorized, especially due to its frequent usage as a literacy marker.

CHAPTER 3: METHODS

3.1 Study Population and Data Source

To examine the knowledge and behaviors of three important health concerns for maternal women (i.e., folic acid consumption, breastfeeding, and infant sleep position), a retrospective secondary analysis trend study design was used. Six years of data in two phases, (i.e., Phase 3:1997, 1998, 1999, Phase 5; 2005, 2007, 2008) from the North Carolina Pregnancy Risk Assessment Monitoring System (PRAMS, 2012) were used for this study. PRAMS data are designed as a means to monitor maternal behaviors. The PRAMS questionnaire collects information on various maternal behaviors surrounding shortly before, during, and after pregnancies that resulted in the delivery of a live birth.

All participating states use the PRAMS (2012) standardized data collection methodology developed by the CDC. The questionnaire consists of two parts. First, there are core questions that appear on all states' surveys, such as information about infant birth weight and adverse pregnancy events. Second, there are state-added questions that are tailored to each state's needs. New mothers are randomly selected from recent birth certificates and the selected women are first contacted by mail. Self-administered questionnaires are then mailed to the identified mothers. The first mailing is sent out approximately two to six months after delivery of a live birth. If there is no response to repeated mailings, women are contacted and interviewed by telephone.

Excluded from the PRAMS (2012) data are the following: (1) out-of-state births to residents, (2) in-state births to non-residents, (3) birth certificates missing the mother's last name, (4) multiple gestations of 4 or more siblings, (5) births to mothers, who are 12 years old or younger, and (6) women whose educational level is not given. Additional exclusions for this particular study were women under the age of 18 since they are not expected to have a high school education.

The PRAMS (2012) data utilize weighted percentages to adjust for nonresponse, noncoverage, and sampling fractions, making the data representative of the entire North Carolina population. The key factors that are used to ensure the data represent all live births in North Carolina are maternal age, race, education, marital status, trimester of first prenatal care visit, and parity, or total number of live births.

The PRAMS (2012) data are composed of phases so that it can be revised periodically. Phase 3 includes the years 1997, 1998, and 1999, and Phase 5 encompasses the years 2005, 2007, and 2008. Phase 4 was not used so that the trend between the years when health literacy was first defined and acknowledged as a significant health problem (i.e., 1997,1998, and 1999) could be compared to the latest data available (i.e., 2005, 2007, and 2008). The response rate was above 70% for each year except 2005, which had a response rate of 68%. The year 2006 had a low response rate (59%) for the NC PRAMS data, for that reason, this year was not used in these analyses.

When educational attainment is the main focus of a study, the PRAMS (2012) data are an excellent source because they obtain this information from the infant's birth certificate and omit participants with a missing value for educational attainment. For all six years included in this dataset, there were only 30 participants with this value missing and they were excluded from the analyses.

3.2 Outcome Variables

This study examined the knowledge and behavior of folic acid consumption, breastfeeding, and infant sleep position. Tables 5 and 6 include a complete list of all survey questions stratified by Phase. Some of these survey questions were somewhat different between the two Phases. For example, Phase 3's survey question concerning breastfeeding asks, "For how many weeks did you breast-feed your new baby? With check boxes, (1) ____weeks, (2) ____I didn't breast-feed my baby, (3) ____I breast-fed less than a week, and (4) I'm still breast-feeding. The corresponding survey question in Phase 5 is worded as, "Did you ever breastfeed or pump breast milk to feed your new baby after delivery? With check boxes, (1) ____no and (2) ___yes. In this example, initiating breastfeeding at all was coded as yes and not initiating breastfeeding was coded as no.

The survey questions on the knowledge of the particular variable asked if the participant had ever heard of or knew the information. The behavior question sought to determine if the knowledge of the variable was then put into action. The knowledge of folic acid consumption was established by asking the new mother if she had heard that this vitamin would prevent some birth defects and the behavior was how often these women knew they were taking the supplement. The knowledge of breastfeeding was determined by having a healthcare provider discuss this during a prenatal visit, and the behavior was the actual time spent breastfeeding. The knowledge of infant sleep position was determined the same as for breastfeeding and the behavior was determined by the actual placement of the infant for sleep most of the time. All outcome variables are categorized dichotomously: having the knowledge or behavior versus not having the knowledge or behavior during the most recent pregnancy.

3.3 Primary Independent Variables

To explore the first specific aim (the association between educational attainment and the health knowledge and behaviors of pregnant women in two different time periods, Phase 3: 1997-1998-1999 and Phase 5: 2005-2007-2008), literacy was measured as the highest level of educational attainment. The independent variable is stratified in the PRAMS (2012) dataset into the following five educational grade level categories, $\leq 8^{th}$, $9^{th} - 11^{th}$, 12^{th}, $13^{th} - 15^{th}$, and $\geq 16^{th}$.

To examine the second specific aim (the trend from Phase 3 and Phase 5 in the health knowledge and behaviors of pregnant women), the data was analyzed separately for women with varying educational attainment levels. These phases of the PRAMS (2012) data were strategically picked to coincide with the latest data obtainable and the data around the time that health literacy was first identified as a significant health concern, 1998. Enough time has lapsed to analyze if there have been positive changes in our healthcare system for the betterment of those with low health literacy.

3.4 Control Variables

The independent variables used in the multivariate models represent factors that either have been associated with health literacy in previous research or are considered to be associated with health literacy and maternal women. Please see Tables 5 and 6 for a complete listing all variables, the survey questions from each PRAMS (2012) Phase, and a brief rationale for use in the present study.

The confounders were identified prior to the research. They are divided up into categories for easier identification: (1) socioeconomic factors (i.e., age, race, ethnicity, marital status, parity, income, non-Medicaid insurance, and Medicaid), (2) psychological factors (i.e., planned pregnancy, prenatal stress, and postpartum depression), and (3) birth characteristics (i.e., infant intensive care admission and single birth).

3.5 Missing Data

Missing data are frequently a problem when using historical data. For this reason, the covariates were carefully thought out for use in these analyses. After theoretically choosing the variables as covariates, any covariate that had 10% or more missing data, a separate dummy category was created to include as predictors in the regression analyses.

In an effort to use the correct covariates to get the most accurate statistical results, two models were set up for the adjusted analyses. Model 1 used all variables theoretically considered as potential confounders, which could adversely affect the relation between the independent and dependent variable and thus, lead to an incorrect rejection of the null hypothesis. These variables are: (1) parity (i.e., previous live birth), (2) non-Medicaid insurance, (3) Medicaid, (4) planned pregnancy, (5) postpartum depression, (6) infant in Intensive Care Unit, (7) income, (8) age, (9) race, (10) ethnicity, (10) single birth, (11) prenatal stress, (12) postnatal depression, and (13) marital status. Model 2 used only the most common confounding variables used in most educational attainment research: (1) age, (2) race, (3) ethnicity, (4) income, (5) non-Medicaid insurance, and (6) Medicaid. Tables 5 and 6 have a complete listing of all variables, the survey questions from both Phases for comparison, and a brief rationale for use as a confounder in the present study.

3.6 Statistical Analyses

After obtaining descriptive data on all variables used in this study, multiple logistic regressions were used to analyze both specific aims. For Specific Aim 1 (to examine the association between educational attainment and the health knowledge and behaviors of pregnant women in the two different time periods, Phase 3: 1997-1998-1999 and Phase 5: 2005-2007-2008), differences in the effect of educational attainment on health knowledge and outcomes for the two periods were considered. P-values, confidence intervals, and odds ratios for the unadjusted, and both adjusted models indicated the significant differences in the effect of educational attainment on health knowledge or behaviors in each phase, where twelve years of education served as the reference group.

Specific Aim 2 (to examine the trend from Phase 3: 1997-1998-1999 to Phase 5: 2005-2007-2008 in health knowledge and behaviors of pregnant women separately for women with varying educational attainment levels), considered the trend in health knowledge and outcomes over the two periods. Separate models estimated for all five educational attainment levels. P-values, confidence intervals, unadjusted, and adjusted odds ratios for time indicator denoted the trend in health knowledge and behaviors for each educational attainment subgroup.

In the multivariate models the covariates age, race/ethnicity, income, insurance/Medicaid, planned pregnancy, prenatal stress, postpartum depression, marital status, single birth, parity (i.e., number of previous live births), and infant being in the Intensive Care Unit were entered into the full model and the covariates: age, race/ethnicity, income, insurance/Medicaid were analyzed as an alternate model for comparison.

The data were analyzed with the SAS 9.2 software (SAS Institute, Cary, North Carolina). This statistical software takes into account the complex survey sampling methods utilized in the PRAMS (2012) data. Procsurvey analysis was used within SAS to weigh the results for national representativeness. Even though this is a study using non-identifiable secondary data, the University of North Carolina at Charlotte Institutional Review Board approved and oversaw it for ethical correctness.

CHAPTER 4: RESULTS

4.1 Maternal Characteristics

Background and Demographic Variables. There were a total of 11,906 maternal women who had given birth to a live infant from two Phases of the PRAMS (2012) dataset included in this dataset. Both Phase 3 and Phase 5 had a total of 5,953 participants. Breaking it down further, Phase 3 had 1,169; 2,373; and 2,411 participants in the years 1997, 1998, and 1999, respectively, and Phase 5 had 1,517; 2,324; and 2,012 in the years 2005, 2007, and 2008, respectively.

An examination of the socio-demographic characteristics of the women in the two different Phases of the PRAMS (2012) data sample revealed that most of the participants in both Phases (*n*=8,503) were white (68%), between the ages of 18-32 (71%). An income of between $10,000-$24,999 in Phase 3 (30%) and greater than $50,000 in Phase 5 (29%) was reported. Most of the participants (*n*=8,503) were married (63%), and had a single birth (94%). Most women (*n*=8,158) reported this was a planned pregnancy (57%). Just over half of the women (*n*=8,405; 52%) had other children. Table 7 reports Phase 3 and Table 8 reports Phase 5 descriptive information by education attainment level. Table 9 reports the means and standard deviations for each variable associated with this research for each phase and for the full sample.

Additionally, 61% of the women (*n*=4,409) in Phase 3 and 50% of the women (*n*=4,064) in Phase 5 reported having non-Medicaid insurance**,** and another 13% of participants (*n*=8,482) in each Phase reported they received government assistance in the form of Medicaid. About 29% of the women (*n*=8,364) had complications during birth causing the infant to be placed in Intensive Care in both Phases. In Phase 3, 26% of the women (*n*=4,374) reported they had some degree of postpartum depression, while in Phase 5 (*n*=4,025) this percentage rose to 40%.

<u>Dependent Variables: Knowledge and Behavior</u>. Tables 7, 8, and 9 also contain descriptive statistics for all six of the dependent variables, including the knowledge and behavior of folic acid consumption, breastfeeding, and infant sleep position, respectively. Most women (*n*=8,419) in both Phases reported having knowledge of proper folic acid consumption (79%) prior to and during a pregnancy, but only 45% of the participants (*n*=8,452) reported they actually consumed folic acid supplements.

Breastfeeding data between the two Phases varied significantly. Eighty-eight percent of the participants (*n*=4,311) in Phase 3 heard about the benefits of breastfeeding their infant from their healthcare provider, but only 44% of the women (*n*=2,762) actually breastfed their infant. The results in Phase 5 are much more encouraging; 86% of the participants (*n*=3,955) reported they heard about the importance of breastfeeding, and 74% of participants (n=3,904) reported they breastfed their infant.

Similarly, with respect to infant sleep position, 84% of the women in Phase 3 (*n*=4,261) and Phase 5 (*n*=3,920) reported their healthcare provider had spoken with them about placing their infant to sleep on their back, while only 46% of the participants (*n*=3,876) in Phase 3 stated that they used the back position predominantly. Phase 5 had better results, with 65% of the women (*n*=3,871) reporting that they used the back position when their infant slept.

4.2 Educational Attainment Characteristics

Descriptive Overview. Thirteen participants in Phase 3 and another 17 participants in Phase 5 did not report their highest-grade completion and were not included in these analyses. A total of 402 (6%) teenagers gave birth to a live infant in Phase 3 and 241 (3%) in Phase 5. These teenagers were omitted from the analyses since they are not expected to have the same level of knowledge and subsequent behavior regarding childbirth issues as compared to adult women.

Educational Attainment and Dependent Variables. Most women (*n*=4,425; 34%) in Phase 3 reported a high school education. Of the participants (*n*=5,936) in Phase 5, 29% reported having 16 years or more of schooling, while another 28% reported a high school education. Of the participants in the two lowest education attainment groups ($\leq 8^{th}$ and 9^{th} – 11^{th} grades), 4% of all participants (*n*=4,425) in Phase 3 and 5% of women (*n*=5,936) in Phase 5 had not completed ninth grade and another 17% of the participants (*n*=4,425) in Phase 3 and 15% of the women (*n*=5,936) in Phase 5 had completed between nine and eleven years of education.

Table 7 presents the descriptive data stratified by education from Phase 3 and Table 8 represents the same variables from Phase 5. In Phase 3, most participants (*n*=4,383) in every education attainment level reported they had heard or read that taking folic acid would prevent some birth defects. However, most of the participants (*n*=4400) who responded positively to actually taking folic acid prior to or during their pregnancy were in the groups with at least some college education. The results in Phase 5 were similar, with most participants (*n*=4036), of all educational levels, indicating that they had knowledge about folic acid, but only those in the highest educational level had most women (*n*=4052) reporting taking folic acid prior to or during their pregnancy.

In Phase 3, in all educational levels, most participants (*n*=4311) responded positively when asked if a healthcare provider discussed breastfeeding with them during a prenatal care visit. However, only in the two college-educated categories did most of the participants (*n*=2762) report actually breastfeeding their infant. Most women (*n*=3955), responding in Phase 5, in all five educational attainment categories, had knowledge of breastfeeding's benefits, while in Phase 3, most of the women (*n*=3904), in all education categories, initiated breastfeeding or pumped breast milk to feed their baby after delivery.

4.3 Specific Aim # 1 Results

The first specific aim analyzed the association between education and both health knowledge and behaviors in the three areas of folic acid consumption, breastfeeding, and infant sleep position in both Phase 3 and Phase 5. Table 10 summarizes two models, where the results are stratified by educational attainment level: the unadjusted model and model 1, which is an adjusted logistic regression model, containing the following confounding variables: age, race, ethnicity, income, non-Medicaid insurance, Medicaid, married, other children, multiple birth, planned pregnancy, prenatal stress, postpartum depression, and infant in the Intensive Care Unit. Tables 5 and 6 report all variables of interest in the present study, their survey questions for each Phase of the PRAMS (2012) data, and a brief rationale as to the reason for inclusion in the present study.

Table 11 reports results on the six dependent variables stratified by education level for an adjusted model that uses a smaller set of covariates, including: age, race, ethnicity, income, non-Medicaid insurance, and Medicaid. These models are estimated separately for each Phase to allow for a comparison of the effect of education on the six dependent variables across phases. A *p-value* of .05 was used to test for significance in all three models.

Folic Acid Consumption Knowledge

Phase 3 (1996-1997-1998). Women with less than a high school education were less likely to have heard or read that taking folic acid could prevent some birth defects than women with a high school education. Using a significance level of 5%, the knowledge for women with less than a high school education was significantly lower in the unadjusted model (e.g., ≤8^{th} grade, OR= 0.52, *p*=<.0001) and in adjusted model 1 using all covariates for all women of low educational attainment (e.g., ≤8^{th} grade, OR=0.57, *p*=0.04). Knowledge was significantly lower among women with a 9^{th} – 11^{th} grade education in adjusted model 2 (OR=0.64, *p*=<.0001), which included the covariates: age, race, ethnicity, income, non-Medicaid insurance, and Medicaid. In all three models, women with more than a high school education were more likely to have heard that folic acid could prevent birth defects than their counterparts with less education (e.g., in adjusted model 1, 13^{th} – 15^{th} grade, OR=1.70, *p*=<.0001).

Phase 5 (2005-2007-2008). Women with very low education did not have significantly lower folic acid knowledge when compared to women with 12 years of education (e.g., ≤8^{th} grade, adjusted model 1, OR=0.88, *p*=0.64). Statistical significance was found in this later period for women with higher education (e.g., ≥16 grade, adjusted model 1, OR=3.18, *p*=<.0001), indicating that women with higher education had folic acid knowledge that was significantly higher than women with 12 years of education.

Folic Acid Consumption Behavior

Phase 3 (1996-1997-1998). When compared with high school educated women, women with less than 12 years of education did not have significantly different folic acid behavior in the adjusted models. However, women with more than a high school education in all models were significantly more likely to take folic acid than their counterparts with a high school education (e.g., ≥16th grade, adjusted model 1, OR=1.82, *p*=<.0001).

Phase 5 (2005-2007-2008). Similar to Phase 3, when compared with high school educated women, women with less than 12 years of education did not have significantly different folic acid behavior, but women with more than 12 years of education did have a significantly higher likelihood of taking folic acid in all models (e.g., ≥16th grade, adjusted model 1, OR=2.25, *p*=<.0001).

Breastfeeding Knowledge

Phase 3 (1996-1997-1998). The only significant difference between women with 12 years of education and women with other education levels was found for women in the highest level of education (i.e., ≥16th grade), where these women reported less breastfeeding knowledge in this area in the unadjusted model only (OR=0.58, *p*=<.0001).

Phase 5 (2005-2007-2008). Women with no more than an 8th grade education were significantly more likely to have heard about breastfeeding than those with a high school education in the unadjusted model only (OR=2.50, *p*=0.03). Women with 16 or more years of education were significantly less likely to have knowledge of breastfeeding than those women with just a high school education in all three models (i.e., ≥16th grade, adjusted model 1, OR=0.62, *p*=0.01).

Breastfeeding Behavior

Phase 3 (1996-1997-1998). Women between a 9^{th} – 11^{th} grade education level were significantly less likely to breastfeed when compared to those with a high school education in all three models (e.g., adjusted model 1, OR=0.64, *p*=0.04). In the unadjusted model, women with an 8^{th} grade education or less were more likely to breastfeed their infants than women with a high school education (OR=1.84, *p*=0.01). But, this result did not hold up when covariates were added in the adjusted models. In all models, women with more than a high school education were more likely to breastfeed than their high school counterparts (e.g., ≥16^{th} grade, adjusted model 1, OR=4.49, *p*=<.0001).

Phase 5 (2005-2007-2008). Women with an 8^{th} grade education or less were more likely to breastfeed their infants than women with a high school education in the unadjusted model only (OR=2.79, *p*=<.0001). Women with more than a high school education were more likely to breastfeed than their high school counterparts in all three models.

Infant Sleep Position Knowledge

Phase 3 (1996-1997-1998). No significant relationship between educational attainment and infant sleep position knowledge was found in any of the 3 models.

Phase 5 (2005-2007-2008). No significance was found for women with less than a high school education, indicating no significant difference between this group and women with 12 years of education. In the unadjusted model, women with the highest level of education were less likely to report they had knowledge of the correct infant sleep position as compared to women with a high school education (OR=0.63, *p*=<.0001). This significant result did not hold for either of the adjusted models.

Infant Sleep Position Behavior

Phase 3 (1996-1997-1998). Women between a 9th – 11th grade education level in the unadjusted model (OR=0.76, *p*=0.04) and in the adjusted model 1(OR=0.71, *p*=0.02) were statistically less likely to put their infant to sleep correctly as compared to women with a high school education. Women with an 8th grade or less education in adjusted model 2 (OR=0.56, *p*=0.03) were also less likely to put their infant to sleep correctly than women with a high school education. A significant difference between women with 12 years of education and more than 12 years of education was seen in the unadjusted model only; women with some college (13th – 15th grades) were slightly less likely to place their infant to sleep in the correct position, compared to high school graduates (OR=0.98, *p*=<.0001), while those in the highest education level were more likely to use correct infant sleep position (OR=1.52, *p*=<.0001).

Phase 5 (2005-2007-2008). Participants with an 8th grade education or less were less likely to report proper sleep position for their infant than high school education women in both adjusted models (mode1 1, OR=0.54, *p*=0.01; model 2, OR=0.56, *p*=<.0001). Women in the highest educational level (≥16th grade) were more likely than high school graduates to position their infant correctly for sleep in all three models (e.g., adjusted model 1, OR=1.35, *p*=0.03).

4.4 Specific Aim # 2 Results

The second specific aim analyzed the trend in both health knowledge and behavior in the three areas of folic acid consumption, breastfeeding, and infant sleep position separately for each of the five education levels. For these models, Table 12 contains the estimated odds ratio on a binary indicator for whether the observation was in Phase 5 (=1) or Phase 3 (=0). An odds ratio greater than one indicates that the positive knowledge or behavior variable was higher in Phase 5 than in the earlier Phase 3. The following variables were used to control for confounding in adjusted model 1: age, race, ethnicity, income, non-Medicaid insurance, Medicaid, married, other children, multiple birth, planned pregnancy, prenatal stress, postpartum depression, and infant in the Intensive Care Unit. Adjusted model 2 utilized only the covariates of age, race, ethnicity, income, non-Medicaid insurance, and Medicaid. The results from an unadjusted model are also presented. As before, a p-value of .05 was used to test for significance in all three models.

Folic Acid Knowledge. Women with a high school education or less in the latter time period were significantly more likely to have heard or read that taking folic acid would help prevent birth defects when compared to women in Phase 3 (e.g., $\leq 8^{th}$ grade, adjusted model 1, OR=5.76, p=<.0001). No significant difference was found between high school educated women and participants with educational levels past high school.

Folic Acid Behavior. All three models indicate that women with some college (13^{th} – 15^{th} grades) in the latter period of time were less likely to report taking folic acid (adjusted model 1, OR=0.67, p=0.02). No other significant trends were found for folic acid behavior.

Breastfeeding Knowledge. No significant difference was found between time periods for women with less than a 12^{th} grade education. Women with a high school education and beyond in the later period were less likely to report their healthcare provider had discussed breastfeeding with them when compared to women in the early Phase (e.g., 12th grade, adjusted model 1, OR=0.67, p=0.04).

Breastfeeding Behavior. In all three models, women of all educational levels in Phase 5 were more likely to initiate breastfeeding than women in the earlier Phase (e.g., 12th grade, adjusted model 1, OR=3.65, p=<.0001).

Infant Sleep Position Knowledge. Women in the highest educational level in the later period were less likely to report that their healthcare provider had spoken with them about placing their baby to sleep on his or her back when compared to those in the earlier Phase, only in the unadjusted model (OR=0.71, p=0.01).

Infant Sleep Position Behavior. Women in the later time period of all education levels were more likely to correctly place their infant to sleep on their back when compared to the earlier time period. In the adjusted models, a significant difference across Phases was found for women ranging from a 9th grade education to those with a 15th grade educational attainment level (e.g., 12th grade adjusted model 1, OR=1.59, p=<.0001).

CHAPTER 5: DISCUSSION: INTEGRATION OF RESULTS

The theoretical underpinnings that guided the present study, the IOM Framework (refer to Figure 1) suggests there is an association between literacy and health outcomes (Nielsen-Bohlman et al., 2004). Specific to the present study, the health outcomes measured were the maternal knowledge and behavior of folic acid, breastfeeding, and infant sleep position. As seen in this framework, one’s health literacy has a direct link to one’s health outcomes. One’s health literacy is contingent upon one’s literacy (i.e., education attainment) and various health contexts. In the present study, many health contexts were analyzed as confounders. Literacy was measured using five education levels. Two models were analyzed using varying health contexts so that the mediator effects could be closely examined. In most cases, when significance was found in one model, it was also found in the other model, indicating that all health contexts were equally important.

Several notable statistically significant results emerged regarding women with either low education or college education, when compared to women with 12 years of education, in terms of their knowledge and behavior in the areas of folic acid consumption, breastfeeding, and infant sleep position and will be discussed separately for each health outcome.

5.1 Folic Acid

Concerning the first knowledge variable of interest, folic acid, the survey question asks the participants (n=8419) if they had ever heard or read that taking the vitamin folic acid helps prevent some birth defects. First, the present study found that women with less than a high school education had less knowledge of folic acid when compared to women with a high school education. In addition, women with some college education were more likely to have knowledge of folic acid and consume folic acid when compared to high school graduates. Previous research has found similar results. Amitai et al. (2008) found a positive relationship when they researched both women's knowledge and consumption of folic acid, examining three years (i.e., 2000, 2002, and 2005) of data separately. Women with less than a high school education were less likely to be aware of and have knowledge of folic acid when compared to all women of higher education. Sharp et al.'s (2009) findings also suggest that women with less than a high school education were much less likely to have knowledge of the benefits connected to folic acid consumption.

When the trend was analyzed in the present study there were two interesting findings. First, there was no significant change over time in folic acid knowledge in women with more than a high school education. Second, the odds of women with less than a high school education having the knowledge of folic acid was greater in the later period. It is encouraging that the present study found a positive trend in the area of folic acid knowledge among women of low education levels. These findings suggest a growing awareness among women in the present study, with less education, about the importance of folic acid during pregnancy.

One main reason for this increased knowledge of folic acid may be the widespread publicity about the Federal Drug Administration's (FDA) fortification of folic acid in grains (Junod, 2009). This initiative, mandated in the late 1990's, utilized public service advertisements to explain folic acid as a food additive. It is imperative for women to trust and rely on public service announcements, particularly concerning folic acid because it must be consumed prior to a pregnancy to prevent birth defects, or at least in the very early weeks of a pregnancy. But, in most instances, a woman would not see her healthcare provider, concerning a new pregnancy, until *after* this critical time period. This scenario makes getting important information about folic acid through a healthcare provider difficult.

Additionally, if prenatal care is delayed for any reason, public health announcements may be the most effective way to educate women about folic acid. There are numerous reasons why women delay formal prenatal care. As one key example, women may delay getting healthcare in the event of an unplanned pregnancy (CDC, 2012c). The CDC reports that unplanned pregnancies may account for as many as half of all pregnancies in the U.S., a number that is close to the proportion of unplanned pregnancies reported in the PRAMS data analyzed in the present study (43%; n=8158). Even if women do not delay seeking healthcare, many healthcare providers cannot schedule the first visit right away. Consequently, there may be a waiting period longer than the critical timeframe for taking folic acid in order to prevent birth defects. Clearly, women need to learn about the importance of folic acid before the initial prenatal care visit.

However, previous research does not suggest that women rely on these announcements for their health information. Earlier research found the women are more likely to take this vitamin based primarily on their healthcare provider recommendations (March of Dimes, 2008). When comparing where patients get health information, Dawson et al. (2001) found that the women in their study were more likely to report that a women's physician were their primary source of folic acid information, as opposed to the media or other sources. Amitai et al.'s (2008) more recent study found the Internet and their physician as the two sources that were significantly related to knowledge and utilization of folic acid.

Pertaining to folic acid consumption, the present study found no statistically significant differences in actual consumption of folic acid between women with less than a high school education and those with a high school education. As far as women with higher education, they were more likely to consume folic acid compared to those with a high school education. But, no differences were found when analyzing the present study's trend results between the two timeframes, except with women who had completed some college (13^{th} – 15^{th} years). These women were less likely to consume folic acid in the later period when compared to their counterparts in the earlier period.

One reason advances were not seen in the present study's trend might also be connected to the government fortification of folic acid in grains as a protective measure for infants. Women may erroneously feel they are consuming enough folic acid if they are taking these fortified substances and therefore eliminate the supplement (Junod, 2009). Women may also prefer to consume foods that contain folic acid rather than take a supplement, especially during a pregnancy when women are asked to carefully consider what foods they consume. In short, public service announcements are important concerning folic acid consumption for pregnant women. These advertisements should clarify that the fortification in foods is at an extremely low level. These messages need to educate women that it is important to eat fortified foods in addition to taking a daily supplement for their folic acid requirements.

5.2 Breastfeeding

Concerning the second knowledge variable of interest, breastfeeding, the survey question asks the participants if a healthcare provider talked to them during a prenatal care visit about breastfeeding their baby. The interest here is beginning an interaction with their healthcare provider on breastfeeding, so that pregnant women can get correct information from the best source, their healthcare provider. With the exception of one unadjusted and one adjusted (model 2) model, no statistically significant differences were found in the present study between women with low education and those with a high school education. Furthermore, there were also no differences found in the trend between the two time periods among low literate women concerning breastfeeding knowledge.

Women in the highest educational level were less likely to have a healthcare provider discuss breastfeeding when compared to women with a high school education. The trend for women with higher education attainment found the women in the later time period were less likely to have breastfeeding discussions with healthcare providers than women in the earlier time period. These findings are in line with the recent CDC (2012b) report entitled, the *National Survey of Maternity Practices*. According to this report, more than 96% of hospitals do not fully support breastfeeding since they fail to include staff training on breastfeeding education for new mothers. When hospitals do not train their healthcare providers and advocate for breastfeeding, women's knowledge about breastfeeding will suffer. But, promoting breastfeeding is not a high priority for some healthcare providers nowadays (Romm, 2011), which, in turn, affects women's breastfeeding behavior.

In the present study, women with higher education were less likely to report they had heard about breastfeeding from their healthcare provider. It is often expected that women with low literacy will have trouble understanding complex health information, but this difficulty may affect women with some college education as well. Complex health information can be a significant problem for individuals regardless of their educational background (Nielsen-Bohlman et al., 2004). In a previous study, well-educated pregnant women, who had access to a wide range of information, still felt unprepared for childbirth and motherhood, a result that they attributed to the complexity of health information (Carolan, 2007). Women of all educational backgrounds are affected by unfamiliar medical terms, terminology, and jargon (Nielsen-Bohlman et al.). Perhaps, health care providers assume that women with a higher education already have knowledge about the benefits associated with breastfeeding their infant.

Regarding breastfeeding behavior, significant differences were found in the present study. When considering only the adjusted models, women between a 9^{th} – 11^{th} grade education were less likely to initiate breastfeeding than those with a high school education. As expected, the more highly educated women were more likely to breastfeed than their counterparts. This significance occurred in all models.

The present study did have contradictory findings when the unadjusted models were considered, which suggests that a number of the confounding variables are strongly related to education in these models. Two examples of confounders not used in this study, but theoretically thought to weigh on the decision to breastfeed, are alcohol and smoking. Women who want to smoke and drink alcohol may choose not to breastfeed to prevent harming their baby. These two variables were considered for inclusion in model 1 for the present analysis, but over 50% of the women surveyed did not answer the questions pertaining to these two factors. Even if women answered them, there is the possibility that the answers are not reliable. Thus, they were not included in model 1.

Clearly, it is difficult to include all the social and psychological factors that could affect a woman's decision to breastfeed in a retrospective study. Women do not breastfeed for many reasons and may base their decision to breastfeed on a number of personal or other reasons, including a wide range of employment policies and laws concerning breastfeeding. For instance, the prevalence of breastfeeding is notably higher in countries where mothers are given paid maternity leave for at least one year (Hofvander, 2003). It is only recently in the United States that federal and state lactation policies have been implemented (National Conference of State Legislatures, 2012). As one example, President Obama signed a law requiring employers with 50 or more employees to provide adequate time to breastfeed for the first year of life (National Conference of State Legislatures). The employer does not have to compensate the mother for any work time spent expressing breast milk but the employer does have to provide a place, other than a bathroom.

As seen above with breastfeeding knowledge, the importance of breastfeeding may not be the main focus for prenatal visits with healthcare providers; yet, its importance has received a lot of publicity that may affect a woman's decision to breastfeed. Organizations, such as the AAP (2005a), ADA (Dobson & Murtaugh, 2004), the CDC (2012b), *Healthy People 2020*, (USDHHS, 2012b) and the WHO **(**2012) tout the importance of breastfeeding. Other groups, such as the La Leche League (2012) and numerous birthing and baby centers, have been very instrumental in disseminating information about the importance of breastfeeding. There has also been a great deal of information on 'pumping breast milk' so that infants can have the benefits of breast milk and mothers can be less inconvenienced.

The present study found a positive trend in breastfeeding behavior in the adjusted models at all levels of education. The decision to breastfeed is multifaceted with many personal issues weighing in on the decision that have changed over time. There are also other considerations concerning breastfeeding. The present study only examined initiating breastfeeding, but other aspects of breastfeeding, such as duration and exclusivity, are vitally important.

5.3 Infant Sleep Position

Regarding knowledge of the final variable examined in the present education study, there was only one significant difference between women of all education levels when participants were asked if their healthcare provider had talked with them about placing their baby to sleep on his or her back. There was also no difference in the trend between women in the years 2005-2008 as compared to women a decade earlier in the adjusted models.

One reason for these results may be due to the complexity of the information concerning infant sleep position. Some experts in this area are fearful that people of all educational backgrounds do not understand the importance of placing their infant to sleep on his or her back (Hsu, 2012). Other experts are worried some women do not understand the consequences of not placing their infant to sleep on their back, while other women may feel the problems no longer exist (O'Keefe, 2011). As a means of verifying these concerns, the AAP is currently making changes in the recommendations on this topic (O'Keefe). The AAP has issued a new policy statement and new public service announcements are proposed to replace the 'Back to Sleep' Campaign (Hsu). These announcements include the acronym, 'ABC,' standing for: 'Alone, Back, Crib' and a message of 'Sleep Safe,' which may alleviate some confusion about the correct infant sleep position.

The present study found, with regards to the behavior of infant sleep position, women with less than a 12th grade education were less likely to use the back position than mothers with a high school education. As for women with the highest education level, the present study found they were more likely to use the correct infant sleep position than their high school counterparts. Additionally, the trend analysis indicated women, of all educational backgrounds, in the later time period were more likely to place their infant to sleep on their back compared to women a decade earlier.

The present study findings are in agreement with many previous studies that also found this positive relationship. For example, Corwin et al. (2003) found the positive relationship between education and infant sleep position. However, these researchers also found that the percentages of women placing their babies to sleep on their back in both categories were below national goals. Ottolini et al. (1999), likewise, found a positive relationship between education and infant sleep position, but also found that not many healthcare providers are mentioning infant sleep position to women on subsequent clinic visits. This finding is important to literacy research, since women with less education, often need health information explained to them many times (Nielsen-Bohlman et al., 2004). On the other hand, health care providers may erroneously assume that women with higher education already have knowledge of the importance of placing an infant on their back to sleep.

5.4 Study Limitations

One of the most significant limitations of the present study is that health literacy, as a variable, is difficult to measure, especially when one of the three standardized assessment instruments (i.e., REALM, TOFHLA, and NVS) are not utilized. Therefore, researchers must identify an appropriate proxy for health literacy, such as educational attainment. Although not a perfect measure for health literacy, educational attainment at least enables researchers to further study literacy as related to one's health.

In addition to looking at the findings separately for each of these individual variables: folic acid, breastfeeding, and infant sleep position; there are further explanations that may explain these results when looking at the data collectively. One reason for some conflicting findings may be due to the way this research was designed because a conservative approach was taken for the analyses. That is, a high school education was used as the referent category rather than use the highest education level, which may have affected statistical significance. In this study, those with less education were compared to those with a high school education and those with higher levels of education were also compared to those with a high school education. The results may be been different if the referent category was the highest potential completion level.

Furthermore, as in any study utilizing secondary data, missing data was a concern. However, one advantage to using the PRAMS (2012) data is that it utilizes weighted adjustments to compensate for participant noncoverage and nonresponse. Another advantage to using the PRAMS (2012) data in the present literacy study was that it requires all participants to have recorded their highest-grade completion, which means missing data in education were a very minor concern. As noted earlier, there were a total of only 30 participants, out of over 11,000, who were omitted from this study due to missing education.

In the present study, two additional steps were taken to compensate for missing data. First, for each confounding variable with more than 10% missing values, a dummy variable was created to indicate whether the observation had missing data for the variable, which allowed these individuals to be included in the analyses. Second, two models were analyzed. In the first adjusted model, all confounders theoretically identified as potentially important to the study were included, while the second adjusted model was more parsimonious and included only the variables of age, race, ethnicity, income, non-Medicaid insurance, and Medicaid. The results of the two models could be compared to each other and to the unadjusted results to test for the robustness of the findings to the inclusion or exclusion of sets of confounding variables.

Likewise, as is common with surveys, the accuracy of the information cannot be verified in a retrospective study design. Recall bias is problematic in a survey designed as the present study, whereas answers on the survey are either exaggerated or underestimated depending on the specific pregnancy and birthing experiences (Sica, 2006). Survey responses concerning health-related matters and using medical terminology could be difficult for women of all educational backgrounds to comprehend and remember, but may affect those with low education disproportionally, thus affecting the results, which leads to a bias in either direction.

It is also possible that there was selection bias in the overall make-up of the respondents since there is a chance that women with low literacy may have been less likely to understand the written survey and to complete and return a self-administered questionnaire. However, the PRAMS (2012) data accounts for this variance by providing sample weights that allow the researcher to adjust for lower response rates for certain population subgroups. The PRAMS also reduces this bias because researchers make several attempts to get a completed survey back from each randomized participant. When a survey is not returned, the researchers will contact the participant numerous times and try to complete the survey by telephone.

Furthermore, the participants in this study were being asked to recall their knowledge from before and at the beginning of their pregnancy. It may be difficult for participants to discern their knowledge level at that earlier point in time. This is especially true during a pregnancy when women may be overwhelmed with a lot of new and complex information that they find difficult to comprehend.

Because a secondary dataset was utilized, there was also no way to control for any important health characteristics, such as pre-existing conditions before or during the pregnancy. For instance, in a breastfeeding study, it would be useful to control for the mother returning to work, but this was not asked in Phase 3 of the PRAMS (2012) survey. Mothers may not initiate breastfeeding because they are returning back to work shortly after their infant's birth. Similarly, it would have been beneficial to control for paternal acceptance of breastfeeding, as this would affect a woman's breastfeeding decision. Another health context that was not considered, yet previous research has found to be important is previous sexual abuse, which can cause a woman not to consider breastfeeding (Prentice, Lu, Lange, & Halfon, 2002). The present study could not control for some lifestyle considerations because they were not asked on the PRAMS (2012) survey.

Generalizability of the present study is limited to North Carolina as a single-state study using data from several years. The results cannot be generalized across other years, to other states, or beyond women whose pregnancies resulted in outcomes other than a live birth.

5.5 Recommendations for Future Research

There are several key recommendations for future research, regarding maternal women with low literacy when considering their health knowledge and behavior of important health information. First, and probably most importantly, research is needed in the area of literacy, health literacy, and educational differences. Specifically, more research is needed to delineate how these terms correlate and how their differences are reported analytically. Health literacy researchers are very aware of the differences in these terms on a theoretical level, but research is needed to explore associations more fully in all groups of people. Because health literacy is not well measured, additional time should be spent trying to create a worthwhile instrument that captures all of the concepts associated with it, in one short tool. As noted earlier, when one of the three standardized measures of health literacy are not employed in a research study, it is challenging to compare and contrast the results across health literacy studies.

Furthermore, a larger study including the knowledge and behavior of other important health concerns for pregnant women is warranted. It is suggested that the Health Literacy Framework (Nielsen-Bohlman et al., 2004) is used for those studies as well. This additional research would begin to assemble a knowledge base concerning women with low education and information related to a pregnancy. Also, the present literature review found significant gaps in the knowledge of low education in pregnant women of different race and ethnicities. For example, Chin et al. (2008) found no significant interaction between education levels of blacks versus whites related to initiating breastfeeding, whereas Krause and Lovelady (2011) found education had an effect with black mothers but not with white mothers. This is an area that needs to be fully explored along with cultural considerations. Socioeconomic factors should also be explored in relation to maternal women and their educational level. Research in this area may lead to an examination of the effects of reducing health disparities for certain groups of people.

For instance, some of the health contexts used in the present study are pertinent to maternal women and should be investigated more fully. More than 80% of women in the U.S. will become pregnant and give birth to at least one child (CDC, 2012d). One-third of these women will suffer pregnancy complications, like postpartum depression or prenatal stress. Some of the complications may harm the infant, causing the infant to be placed in the Intensive Care Unit.

Other considerations would include the use of longitudinal study and qualitative research study designs. For example, studying the health outcomes related to women with low literacy in subsequent pregnancies over time could follow key health outcomes of their offspring. In addition, pregnant women are suitable for qualitative research and possibly much more can be learned through a focus group session with several well-planned questions over several meetings. Not only will this provide good research results, but the participants can also learn about their pregnancy in the process.

5.6 Implications for Policy and Practice

The major implication of the present study is that some women in North Carolina are not receiving the health information they need to make positive choices concerning a pregnancy. The infant mortality rate of mothers with less than a high school education was 49% higher than the rate of mothers who complete 16 or more years of education (Mathews, Marian, & MacDorman, 2007). One main reason for this may be due to the fact that mothers are not equipped with proper health information pertinent to their care. As a result, they may be unable to follow health directions, which can lead to a wide array of infant problems, such as birth defects, a failure to thrive, or the most detrimental, infant death.

This suggestion is, of course, not entirely based on one's educational background, although this may be a significant source of the problem. Some consequences of poor birth outcomes may be alleviated by a national strategy aimed at increasing healthcare provider awareness of health literacy issues. This could lead to health literacy screenings and assessments of a patient's health knowledge before and after giving birth and could be expanded and applicable to other health situations as well.

Identifying women's knowledge level of applicable health information is key to a successful pregnancy and early motherhood. Healthcare providers need to be aware of when their clients do not understand information and these providers must find the time to go over educational information with their patients and ensure they understand it.

The needs of maternal women would be served more holistically with the introduction of policy and practice regulations regarding pre-conception counseling and early prenatal care. Enactment of these policies could include a plethora of information pertinent to women of childbearing age. These regulations are especially important to information about folic acid because this vitamin must be taken before conception. This type of counseling would also benefit the large number of women who have unplanned pregnancies.

5.7 Significance

In each of the three areas researched in the present study, advances are evident. Concerning folic acid, foods are being fortified with this vitamin and there is research being conducted on increasing that amount of fortification (Junod, 2009). Carefully planned public service announcements are a main source of folic acid information for maternal women, especially for women of low education. Regarding breastfeeding, new national and state enactments are making it easier for women to breastfeed in public (National Conference of State Legislatures, 2012), in the hopes women will initiate breastfeeding. The results of this study provide empirical support as the relationship between maternal knowledge and breastfeeding her infant. Pertaining to infant sleep position, again new policies are being developed for easier to understand public service announcements without catchy slogans (Hsu, 2012), which are sometimes hard for those with low literacy to understand the significance. The findings from this study suggest that folic acid knowledge and behavior, breastfeeding behavior, and infant sleep position behavior may be contingent upon ones education background. Additional research is needed in all these areas concerning ones literacy level, but particularly concerning knowledge of breastfeeding and infant sleep position.

These advances are helpful to maternal women and they are also helpful to healthcare providers because there is so much information to go over with pregnant women in a short clinic visit. Information concerning women's health knowledge and subsequent behavior regarding various maternal health concerns during a pregnancy is crucial to the health outcomes of women and their infants.

Table 1: Definitions of Key Terms: Literacy, Health Literacy, Maternal Health Literacy, and Educational Attainment

Term	Conceptual Definition (Source)
Literacy Defined by the National Assessment of Adult Literacy (NAAL)	An individual's ability to use printed and written information to function in society, to achieve one's goals, and to develop one's knowledge and potential. (NAAL, 2010).
Literacy Defined for this study	The knowledge people have acquired through the years of formal education.
Health Literacy Defined by the AMA in 1998	A patient's ability to obtain, process, and understand basic health information and services needed to make appropriate health decisions.(AMA, 2012)
Health Literacy Defined by the WHO in 1998	Health literacy represents the cognitive and social skills, which determine the motivation and ability of individuals to gain access to, understand and use information in ways which promote and maintain good health. Health literacy means more than being able to read pamphlets and successfully make appointments. By improving people's access to health information and their capacity to sue it effectively, health literacy is critical empowerment. (Nutbeam, 1998)
Maternal Health Literacy Defined by Renkert & Nutbeam in 2001	The cognitive and social skills which determine the motivation and ability of women to gain access to, understand, and use information in ways that promote and maintain their health and that of their children." (Renkert & Nutbeam, 2001, p. 382)
Educational Attainment Defined by PRAMS (2012)	Total years of formal education.

Table 2: Previous Research on Educational Attainment and Folic Acid: 2005-2011

Author (Date)	Objective	Study Design	Sample	Literacy Measurement	Results
Hage, Jalloul, Sabbah, Salim, & Adib (2011)	To assess: (1) women's knowledge of folic acid's benefits and the adequate period of its intake, their source of information and the main dietary items containing this vitamin (2) practices concerning folic acid intake during the periconception period	Cross-sectional study	600 married Lebanese women aged 18–45 years	Level of education: (1) Primary (2) Intermediate (3) Secondary (4) University	Younger age, higher education level and stability/sufficiency of income appeared to be significant predictors of awareness among Lebanese women. Highly educated women knew about folic acid more than those with primary educational levels.

Table 2 (continued)

Author (Date)	Objective	Study Design	Sample	Literacy Measurement	Results
Al-Hossani, Abouzeid, Salah, Farag, & Fawzy (2010)	To assess folic acid knowledge and practices among pregnant women in Dhabi	Cross sectional study	Represent-ative sample of 277 pregnant women in Abu Dhabi Emirate	Education: (1) Compulsory (education until 12 years of age) (2) Preparatory or secondary (3) University	Education, irrespective of age or parity, was the major factor determining better knowledge of folic acid in pregnancy. Using multiple logistic regression analysis, the results show that education, irrespective of age or parity, was the major factor determining better knowledge of folic acid in pregnancy ($p < 0.001$). Almost 80% of the participants had heard of FA, but not even half of them had accurate knowledge about the role of FA in preventing birth defects.
Baykan, Ozturk, Poyrrazoglu, & Gun (2010)	To investigate women's awareness, knowledge, and behaviors relevant to folic acid intake	Cross-sectional study	1,083 Turkish women aged 15–49 years	Education: (1) < high school (n=699) (2) high school graduate (n=259) (3) University graduate (n= 125)	Women older than 35 and less educated women were more unaware of folic acid. Results also showed that women with high school education were seven times (OR 7.413, CI 3.067–17.920) and women with less than a high school education were 34 times unaware of folic acid (OR 34.486, CI 14.726–80.761) than university graduates.

Table 2 (continued)

Author (Date)	Objective	Study Design	Sample	Literacy Measurement	Results
Lantz, Edmundson, Kisely, & MacLellan (2010)	To determine: (1) the prevalence of periconceptual folic acid supplementation in Nova Scotia (2) the sources of education regarding folic acid supplementation (3) the factors associated with lack of or improperly timed folic acid supplementation so that those at risk of not using folic acid supplementation could be identified.	Cross-sectional study	484 Canadian women of low socio-economic status	Education: (1) ≤ High school diploma (n=40%) (2) Undergraduate degree, (n=46%) (3) Postgraduate (n=11%)	Older age, a higher level of education, previous pregnancy, being advised to take folic acid and planned pregnancy were significantly associated with taking folic acid appropriately on univariate analysis. Multivariate analysis (adjusted odds ratio) found that a higher level of education, planned pregnancy and being advised to take folic acid by a family physician were independently associated with appropriate use of folic acid.
Rasmussen (2010)	To investigate pregnant women's knowledge about and intake of folic acid supplementation in	Cross-sectional study	84 pregnant women with a midwife	Highest educational level: (1) $9^{th}/10^{th}$ grade from public school	Statistically significant correlation between higher educational level and knowledge about folic acid supplementation in accordance with national recommendation (RR =1.3 (0.97; 1.7), p=0.03).

Table 2 (continued)

Author (Date)	Objective	Study Design	Sample	Literacy Measurement	Results
	relation to pregnancy		consultation	(2) Upper secondary school or corresponding level (3) Short further education (4) Bachelor level or corresponding level (5) Masters degree or corresponding level (6) Students	
Sukchan, Liabsuetrakul, Chongsuvivatwong, Songwathana, Sornsrivicha, &Kuning (2010)	To describe the prevalence of nutrient inadequacy and assess factors associated with nutrient inadequacy	A hospital-based cross-sectional survey	400 pregnant Thailand women who attended antenatal care clinics	Education: (1) Primary (2) Secondary (3) Higher than secondary school	Women with a primary school education were at a high risk for inadequacy of most nutrients. Education was found to have a consistent effect on inadequacy of almost all nutrients. Women who had a primary education or less were 1.5-3 times more likely to have nutrient inadequacy.
Tinker, Cogswell, Devine, &	To describe how different sources of folic acid contribute to	Retrospective, secondary	Data on 2617 nonpreg-	Educational attainment was based on the	Women with higher education were more likely than women with a high school education or equivalent to take a

Table 2 (continued)

Author (Date)	Objective	Study Design	Sample	Literacy Measurement	Results
Berry (2010)	achieving the recommended usual daily intake	analysis	nant U.S. women aged 15–44 years	highest level of school completed (1)Less than high school (2) school graduate or GED (3)More than high school (4)Missing	supplement containing folic acid (Prevalence ratio=1.65; 95% CI=1.28-2.12).
Brough, Rees, Crawford, & Dorman (2009)	Explored periconception folic acid supplement use in a socially deprived, ethnically diverse population	Cross-sectional study	402 pregnant women in the first trimester of pregnancy in East London	Highest maternal qualification (1)None (2) GCSE/O level/CSE (3) A level/ NVQ/HN (4) Degree/ Professional	Mothers from higher social groups or with higher levels of education were more likely to use folic acid and started taking it earlier.

Table 2 (continued)

Author (Date)	Objective	Study Design	Sample	Literacy Measurement	Results
Coonrod, Bruce, Malcolm, Drachman, & Frey (2009)	To determine knowledge and attitudes regarding preconception care in a low-income Mexican American population	Cross-sectional survey	305 reproductive-age women at an urban public hospital	Education: (1) < 12 (2) 12 (3) ≥12	Awareness of folic acid benefits in pregnancy decreased with younger age and lower education. An effect was found by age but not by education.
Fauzi, McKenna, Yusoff, & Rahman, (2009)	To determine the awareness and use of folic acid and determine their relation to maternal socio-demographic factors	Cross-sectional study	194 Women Malaysian women of childbearing age, aged 18-45	Education: (1)< High school (2)High school (3) College/ University	Married pregnant women aged 25-32, with better education and higher income had a significant association with greater folic acid awareness ($p < 0.05$). There were marked differences in awareness according to education level. Among college/university graduate women, 92.3% had heard or read about folic acid, compared to only 53.7% among women with less than high school education ($p < 0.001$). College/university educated women were also 3.2 times more likely to know that multivitamin/folic acid could reduce Neural Tube Defects risk ($p < 0.001$) and were twice more aware of its preconceptual need than less than high school educated

Table 2 (continued)

Author (Date)	Objective	Study Design	Sample	Literacy Measurement	Results
					women ($p = 0.002$).
Molster, Samanek, Bower, & O'Leary (2009)	To measure baseline folate knowledge of folate awareness, knowledge of pregnancy-relevant public health messages and consumer behaviors	Cross-sectional telephone survey	1000 Western Australian residents aged ≥18 years, recruited randomly	Highest education level: (1) <year 12 at secondary school (2) year 12 &/or post-secondary	Associations were detected between knowledge, consumer behaviors & soci-economic indicators including level of education. The odds were significantly lower for those with < 12 years of education (OR_{adj} =0.4).
Sharp, Naylor, Cai, Hyder, Chandra, & Guillory (2009)	To assess women's self-reported awareness, knowledge and use of folic acid	Cross-sectional, random digit-dialing, computer-assisted telephone interviews	250 Kansas women	Education: (1) < High school (n=15; 6%) (2) High school graduate (n=71; 28%) (3) Any college or college graduate (n=164; 66%)	Women with an education > high school were approximately nine times more likely to be aware of folic acid (O.R. 8.83, 95% CI 2.91–26.78). Education > high school was the factor most strongly associated with having a general awareness of folic acid. Awareness was associated with ≥ high school education ($p < .0001$), incomes over $25,000 ($p = 0.0003$), being married ($p = 0.0035$), being white ($p = 0.0135$), having health insurance ($p = 0.0152$) and being capable of pregnancy ($p = 0.0119$).

Table 2 (continued)

Author (Date)	Objective	Study Design	Sample	Literacy Measurement	Results
Amitai, Fisher, Meiraz, Baram, Tounis, & Leventhal (2008)	To assess the efficacy of the ongoing national folic acid campaign launched in 2000	Cross sectional study	1860 pregnant and post-partum women	Education was defined by years of schooling: (1) < 12 years (2) 12 years (3) 13-15 years (4) ≥16 years	Education was significantly associated with compliance: only 13.6% of women with < 12 years of education utilized FA preconceptionally versus 48.1% of women with ≥ 16 years. Awareness, knowledge, timing and utilization increased significantly and were all correlated with years of education ($P < 0.001$).
Hassan & Al-Kharusi (2008)	To assess the knowledge and use of folic acid among pregnant Arabian women in Qatar and Oman	Cross-sectional, convenience sample of women seeking prenatal healthcare at 2 hospitals	300 Arabian women from Qatar and Oman	Education: (1) Illiterate /read and write (2) Preliminary Intermediate (3) high school above	Hearing or reading about folic acid was not associated with respondent's level of education. Positive response to the statement: 'Folate should be taken before pregnancy' was lowest for women in the lowest education level (13.6%). Women in the lowest level of education were much more likely to obtain information about folic acid from their physician (88%) rather than the media (12%).

Table 2 (continued)

Author (Date)	Objective	Study Design	Sample	Literacy Measurement	Results
Quinn, Thomas, Hauser, Rodriques, & Rodriquez-Snapp (2008)	(1) To determine the knowledge and intentions of folic acid use among Puerto Rican and Cuban women in Central Florida (2) To evaluate the usefulness of the educational materials from the ‘‘Story of Three Sisters’’ social marketing campaign among this same group of women	Individual interviews and 9 group interviews	Convenience sample N=7445	Educational attainment: (1) < high school (2) high school (3) some college	Although the majority of the women were educated (some college 31%; college 35% and have lived in the United States for more than 5 years (85%), they could not provide an appropriate definition of folic acid. The majority of the participants did not take a multivitamin with folic acid at the time of the interview. However, after evaluating the materials, 93% of these women said they would begin to take a multivitamin.
Timmermans, Jaddoe, Mackenbach, Hofman, Steegers-Theunissen, & Steegers (2008)	Assessed the prevalence of folic acid use and identified its determinants	A population-based prospective cohort study between 2002 and 2006	6940 women from the Generation R Study Rotterdam the	Educational level was assessed by the highest completed education and classified into three categories: (1) primary education (2) secondary	Most important risk factors for inadequate use were unplanned pregnancy (OR 9.5, CI 7.2–12.4, $p < 0.001$), low educational level (OR 2.5, CI 1.8–3.6, $p < 0.001$) and non-western ethnicity, (OR 3.5, CI 2.9–4.3, $p < 0.001$). For low educational level, the effect estimates were only significant in the Dutch and Turkish population, but not in

Table 2 (continued)

Author (Date)	Objective	Study Design	Sample	Literacy Measurement	Results
				education (3) university or college	Moroccan, Suriname or Antilles, other western, and other non-western populations.
Li, Ren, Zhang, Liu, & Li (2007)	To understand the periconceptional use of folic acid and its association with selected characteristics in northern China	Population-based case – control study on external structural birth defects	48 pregnant Chinese women	Education: (1) <high school (n=410) (2) high school (n=53) (3) ≥junior college (n=13) (4) missing (n=4)	Both any use of folic acid and periconceptional use were significantly more frequent among women with higher levels of education ($P< 0.01$ for any use, $P < 0.05$ for periconceptional use). Any use of folic acid was significantly increased among women with high school education (OR=2.37, $P < 0.05$) and with junior college or higher education (OR =4.25, $P < 0.05$) compared with those having less than high school education.
Wu, Brat, Milla, & Kim (2007)	To characterize determinants of folic acid (FA) use among women of reproductive age and patient education practices of health care professionals in	Cross sectional study	508 female outpatients and 128 health workers were Interviewe	Education: (1) grades 1-6 (2) grades 7+	Given the clear divergence in knowledge between those having more and less than a seventh grade education, it is not surprising that more education is overwhelmingly correlated (OR = 252.52, $P < 0.0001$) with familiarity with FA. 73% of women with education above grade

Table 2 (continued)

Author (Date)	Objective	Study Design	Sample	Literacy Measurement	Results
	one region of Honduras		d in 6 primary care clinics in Honduras		7 took folic acid, and 28% of them took it correctly, while the vast majority (83%) of women with less than a seventh grade education did not take folate. Univariate analysis and successive multivariate analyses revealed that women with more than a seventh grade education were significantly more likely to use folic acid (regardless of timing) as compared with their less educated counterparts (OR = 13.85, $P < 0.000$ and OR = 12.65, $P < 0.000$, respectively). Higher levels of education appear to be the overwhelming influence on actual usage of folic acid.
Bener, Al Maadid, Al-Bast, & Al-Marri (2006)	To determine the level of knowledge about the usefulness of periconceptional folic acid supplementation in a sample of women in the child-bearing age.	Cross sectional survey with 11 primary health care centers and women's hospital in Qatar	1480 Qatari women aged between 18 and 45 years	Level of education: (1) Illiteracy (2) Primary (3) Secondary (4) High School (5) University and	In univariate analysis, awareness of folic acid was significantly associated with education of mother. Higher educated women (41.3%) knew more about folic acid and used it more often in the periconceptional and first trimester period.

Table 2 (continued)

Author (Date)	Objective	Study Design	Sample	Literacy Measurement	Results
				above	
Binns, Scott, Nwafor, Graham, Oddy, & Lee (2006)	The objectives of this study were to document the pre-valence (proportion) of new mothers taking folic acid as supplements or as fortified foods during their pregnancy and to study the factors that determined whether folic acid was taken	A cross sectional analysis of the baseline data of mothers who participated in the Perth Infant Feeding Study was performed	A total of 587 mothers who delivered at the two hospitals in the study completed baseline questionnaires	Education (1) ≤ 10 years (2) 11-12 years (3) >12 years	The significant factors independently associated with not taking folic acid supplements or fortified food were "years of education" (OR '10 years or less' 0.45 (0.23-0.88), "family income" (OR <$25000 0.40(0.20-0.80), and for taking folic acid "the timing of the pregnancy." (OR 'actively trying' 2.01 (0.1.04-0.3.87). The mothers who were not taking folic were less educated, from lower socio-economic groups and were not actively trying to fall pregnant at the time they became pregnant.
Canfield, Przybyla, Case, Ramadhani, Suarez, & Dyer (2006)	To examine folic acid awareness, knowledge, and supplementation practices among women of childbearing age	Residents of Texas–Mexico border as well as women of Hispanic origin /ethnicity were interviewed	In total 1,196 women age 18 to 44	By educational attainment : (1) < high school (2)High school /post secondary (3)College graduate	Education was the strongest predictor of folic acid awareness followed by race/ethnicity and age. Significant predictors of daily folic acid supplementation were education and ethnicity. In multivariate analysis, clear differences were observed among different subgroups of non-pregnant women. African Americans, Hispanics, and those with

Table 2 (continued)

Author (Date)	Objective	Study Design	Sample	Literacy Measurement	Results
					lower educational attainment were less likely than their counterparts to supplement with folic acid daily.
Carmichael, Shaw, Yang, Laurent, Herring, & Royle, et al. (2006)	To describe the timing and correlates of folic acid supplement intake among pregnant women	population-based case-control study	2518 women	Education: (1) <high school (2) high school (3) 1-3 years college (4) 4+ years of college	Women who did not take folic acid supplement periconceptionally tended to be nonwhite, speak Spanish, have low education, and be younger than 25 years old.

Table 2 (continued)

Author (Date)	Objective	Study Design	Sample	Literacy Measurement	Results
Gjergja, Stipoljev, Hafner, Tezak, & Luzar-Stiffler (2006)	Asesses the knowledge and practice regarding FA supplementation and reports the trends in pregnancy planning in Croatia	A cross sectional study	A total of 569 pregnant women	Education: (1) Elementary school (2) Secondary school (3) University	The higher the level of education, the higher the probability of receiving the information about folic acid ($\chi 2$, d.f. 2, value 46.1435, $p < 0.0001$).
Goldberg, Alvarado, Chavez, Chen, Dick, Felix, et al. (2006)	To assess the prevalence and characteristics of pregnant callers who did not use folic acid supplements in the periconceptional period, and explored attitudes toward advice to continue vitamin use following pregnancy in order to be protected in a future	A telephone survey conducted through the California Teratogen Information Service (TIS)	327 pregnant women	Years of completed education: (1) 0-8 (2) 9-11 (3) 12-15 (4) ≥ 16 (5) Refused	Predictors of lack of use included a higher prepregnancy body mass index, younger maternal age, non-white race/ethnicity, lower education level, and unplanned pregnancy. Univariate analysis-Women with less than a high school education (OR, 8.75; 95% CI, 1.99 –38.41) were less likely to take folic acid.

Table 2 (continued)

Author (Date)	Objective	Study Design	Sample	Literacy Measurement	Results
	pregnancy				
Nilsen, Vollset, Gjessing, Magnus, Melzer, Hungen, et al. (2006)	Examined the patterns and predictors of maternal folic acid supplement use from 2 months before pregnancy through the eighth month of pregnancy	Norwegian Mother and Child Cohort Study recorded in 2000 – 2003	22,500 women	Maternal Education: (1) Primary school (2) Secondary School (3) University or college (4) Other	Maternal education and marital status were strong predictors of use. Women with the highest educational level had an RR of 6.0 of use compared with women with the lowest educational level.
Ren, Zhang, Li, Hao, Tian, & Li (2006)	To characterize folic acid awareness and use and to examine the association between folic acid supplementation with blood folate concentrations among early pregnant women in an area in northern China	Cross sectional study	693 early pregnant women	Education: (1) ≤ middle school (2) ≥high school	Women with a middle school education or lower (21.1%) were less likely to be aware of folic acid, and less likely to take folic acid during the current pregnancy.

Table 2 (continued)

Author (Date)	Objective	Study Design	Sample	Literacy Measurement	Results
Robbins, Hopkins, Mosley, Casey, Cleves, & Hobbs, (2006)	To examine folic acid awareness and use among women of childbearing age in a representative, economically at-risk rural sample and identify factors that influence awareness and use	A cross-sectional random digit dialing telephone survey	Repres-entative sample of 646 women aged 14-45 years in 36 counties of the lower Mississippi Delta	Education: (1) <12th (2) 12th grade/GED (3) some college/vocational (4) college degree+ (5) unknown/ refused	The proportion of women who took regular folic acid supplements was very low among some subgroups: African Americans (14%), those 14-19 years of age (12%), and those with low incomes (13%) and low educational levels (14%). There was a statistically significant (p< .0001) association between educational level and folic acid awareness. Of those women with a college degree, 86% reported awareness of folic acid. This is especially striking when compared with women who had not graduated from high school (27% of our sample), of whom only 34% had heard of folic acid.
van Eijsden, van der Wal, & Bonsel (2006)	To investigate the role of language proficiency as determinant of folic acid knowledge and use in a multi-ethnic pregnancy cohort	Prospective cohort study using the Amsterdam Born Children and their Developme	12,373 women	Educational attainment (years): (1) 0-5 (2) 6-10 (3) $\geq$ 11	Knowledge of periconceptional folic acid use, reflecting a woman's comprehension of health education, depended on two factors: proficiency in the dominant language and educational attainment. An important factor determining folic acid knowledge in the non-Western group was educational attainment (high versus low

Table 2 (continued)

Author (Date)	Objective	Study Design	Sample	Literacy Measurement	Results
		nt (ABCD) study			educational level: OR 5.2, 95% CI 3.6–7.5).
Watson, Brown, & Davey (2006)	To determine the proportion of women who took folate supplementation prior to conception and in the first three months of pregnancy and/or increased folate dietary intake To determine how folate supplementation varied with socio-demographic factors; and to describe the ways women had seen or heard about folate prior to pregnancy.	Two population-based surveys were used: the Victorian Survey of Recent Mothers 2000 and the 2001 NSW Child Health Survey	Victorian Survey n=1593 New South Wales Child Health Survey n= 607	Highest level of Education: (1) <Year 12 Completed (2) Year 12 (3) Apprenticeship (4) Diploma (5) Degree	In both surveys younger women, women with less education, less income, of non-English speaking background and women who were not married were < to take folate supplements in the recommended period. In both studies and in both parity groups (primiparous & multiparous), the likelihood of taking folic acid supplement increased with increasing maternal age, with increasing level of education, and with English-speaking background.
Bower, Miller, Payne, & Sema (2005)	To evaluate two population health promotion programs to encourage women to take folic acid supplements, and the	Cross sectional study	Random sample of recently pregnant women in Western	Maternal Education: (1)Tertiary (2)Trade/other	Women who first became aware of the correct message during pregnancy or who were unaware of the correct message before or during pregnancy were more likely than women aware before pregnancy to be younger, having their first pregnancy,

Table 2 (continued)

Author (Date)	Objective	Study Design	Sample	Literacy Measurement	Results
	introduction of voluntary fortification of some foods with folic acid in Australia		Australia	qualification (3)High school only	be single or in a *de facto* Relationship, have no tertiary education, and be a public patient. Similar associations were seen for women taking either no folic acid or < 200mg of folic acid in supplements daily in the periconceptional period. We found that better educated, older and married women, women with private health insurance cove and women who engaged in other health-promoting behaviors (not smoking, taking exercise, planning pregnancy) were more likely to know about the preventive effect of folate and to have taken periconceptional folic acid supplementation.
de Jong-Van den Berg, Hernandez-Diaz Werler, Louik, & Mitchell (2005)	The purpose of this study was to describe recent trends in folic acid awareness and use in the periconceptional period among pregnant women in relation to maternal	Cross-sectional study	16,555 women from the Slone Epidemiology Center Birth Defects	Educational Level: (1) low awareness, <12 years (2) middle awareness, 12-15	Maternal education was a strong independent predictor of both awareness and use. The proportion of women who were aware of folic acid and who used folic acid in the relevant period was approximately 6 times higher in women with a high educational level than in women with a low level of

Table 2 (continued)

Author (Date)	Objective	Study Design	Sample	Literacy Measurement	Results
	sociodemographic and other relevant factors.		Study were interview-ed	years (3) high aware-ness, >15 years	education.

Table 3: Research on Educational Attainment and Breastfeeding: 2007-2011

Author (Date)	**Objective**	**Study Design**	**Sample**	**Literacy Measurement**	**Results**
Hauch, Fenwick, Dhaliwal, & Butt (2011)	To examine infant feeding practices during the hospital stay and at 9 weeks post birth from Western Australian women with a registered live birth between February and June 2006	Cross sectional survey	Data obtained from 2,669 women	Maternal education level: (1) < Year 12 (2) Secondary school year 12 completion (3) Apprenticeship/ diploma (4) Degree/postgraduate	Variables with a significant association with breastfeeding cessation at 9 weeks included: younger maternal age ($P < 0.001$); primiparous women ($P < 0.001$); rural women ($P < 0.001$); women from a public maternity hospital ($P < 0.05$); lower maternal education levels ($P < 0.001$); offering a combination of breast milk and formula in hospital ($P < 0.001$) and caesarean birth ($P < 0.001$). In a multivariable logistic regression analysis, younger maternal age, primiparous women, lower maternal education levels, offering a combination of breast milk and formula in hospital and caesarean birth were significant independent predictors of breastfeeding cessation by 9 weeks.

Table 3 (continued)

Author (Date)	Objective	Study Design	Sample	Literacy Measurement	Results
Krause & Lovelady (2011)	To examine correlates of breastfeeding initiation and intensity in a racially diverse sample of overweight and obese women.	Secondary Data analysis	450 NC women enrolled in a postpartum weight loss intervention Durham, NC	Education was collected in categories and entered as dummy variables into the models as: (1) High school graduate or less (2) College degree (3) Postgraduate degree	In multivariable models education, gestational age, and BMI remained significant predictors of breastfeeding initiation. Increasing education had a significant positive effect on lactation score for black women when separate analysis was completed for blacks and whites.
Maloney, Hutchinson, Burns, Mattick, & Black (2011)	To determine the prevalence and correlates of alcohol use in pregnancy and lactation in a large representative sample of Australian women	Cross-sectional survey	Self-completed questionnaire (n = 19,818) Telephone interview (n = 3,538) Sample of Australian women drawn from the 2007 National Drug Strategy Household	Educational attainment: (1) 10 yr or less (2) 11–12 yr	Higher educational attainment, and breastfeeding for more weeks in the past 12 months were significantly associated with alcohol use while breastfeeding, after controlling for confounding psychosocial factors. Results found links between higher educational attainment and alcohol use in pregnancy.

Table 3 (continued)

Author (Date)	Objective	Study Design	Sample	Literacy Measurement	Results
			Survey		
Akter & Rahman (2010)	The purpose of this study was to assess the duration of breastfeeding and the sociodemographic factors affecting it.	Cross sectional design of data for the study were drawn from the Bangladesh Demographic and Health Survey 2004	5,364 mothers from Bangladesh	Education of the respondent is the highest level of schooling attained, measured as: (1) no education, (2) primary, (3) secondary, (4) higher	The duration of breastfeeding was positively associated with maternal age, contraceptive-use, work status, and religion and was negatively associated with age at marriage, parity, delivery status, region, and maternal education. Younger mothers, having higher education, higher maternal parity, caesarean-section birth, being a Muslim, and mothers who have not used any contraceptive were associated with lower duration of breastfeeding. The risk of cessation of breastfeeding increased with increasing maternal education.
Al-Sahab, Lanes, Feldman, & Tamim (2010)	To examine the prevalence and predictors of 6-month exclusive breastfeeding among Canadian	Retrospective Study using the Maternity Experience Survey targeting	5,615 weighted to represent 66,810 Canadian women	Maternal years of education: Continuous variable	Having higher years of education, residing in the Northern territories and Western provinces, living with a partner, having had previous pregnancies, having lower pre-pregnancy body mass index and

Table 3 (continued)

Author (Date)	Objective	Study Design	Sample	Literacy Measurement	Results
	women.	women aged ≥ 15 years who singleton live births between February 2006 – May 2006			giving birth at older age were associated with increased likelihood of 6-month exclusive breastfeeding. At the multivariate analysis, 'years of education' was the only significant socio-economic predictor of 6-month exclusive breastfeeding.
Bailey, & Wright (2010)	To identify demographic, medical, and health behavior factors that predict breastfeeding initiation in a rural population with low breastfeeding rates.	Retrospective study design, with data obtained through detailed chart review	2323 U.S. women who experienced consecutive deliveries at 2 hospitals in Tennessee	Maternal education: (1) high school education or less (2) some college or more	Only half the women initiated breastfeeding, which was significantly associated with higher levels of education, private insurance, nonsmoking and non-drug-using status, and primiparity, after controlling for confounders. Women 20 years of age and older, those with > high school education, those who were married, and those with private medical insurance were significantly more likely to initiate breastfeeding than the remaining women.

Table 3 (continued)

Author (Date)	Objective	Study Design	Sample	Literacy Measurement	Results
Chaparro & Lutter (2010)	To understand the factors contributing in breastfeeding duration	Retrospective study design from 1986-2005	Between 2600-11,000 mother-child pairs from each of 7 Latin America countries	Mothers education: (1) 1-6 (2) 7-11 (3) ≥ 12	The most important and consistent predictor of whether a mother continues to breastfeed was her level of education. Higher maternal education was associated with a lower probability of breastfeeding at any give age of the child.
Do Nascimento, Reis, Franco, Issler, & Ferraro Gris (2010)	To evaluate infant feeding practices and the identification of weaning risk factors are essential for public health policy planning.	Cross-sectional population survey	Brazilian Caregivers of 1,470 infants were interviewed	Maternal Schooling (years): (1) <12 (2) ≥ 12	The findings associated with the interruption of exclusive breastfeeding for infants up to 6 months were: higher infant age ($P < 0.001$), pacifier use ($P < 0.001$), and lower maternal educational level ($P= 0.013$). A high level of maternal educational background was associated with the continuation of exclusive breastfeeding among infants younger than 6 months.
Kristiansen, Lande, Overby, & Andersen	To identify factors associated with exclusive breast-feeding and	Longitudinal study	A total of 1490 Norwegian mothers/	Maternal Education: (1) Primary/secondary schools	Maternal education was the most stable variable as it was significantly associated with exclusive breastfeeding at most

Table 3 (continued)

Author (Date)	Objective	Study Design	Sample	Literacy Measurement	Results
(2010)	breastfeeding during the first year of life		infants participated at both 6 and 12 months of age.	(2) Comprehensive school (3) Academy/college/ university (≤4 years) (4) Academy/college/ university (>4 years)	ages. A significant linear trend of increasing odds of not introducing solid foods before 4 months of age was found with increasing maternal education.
Ku & Chow (2010)	To explore the relationships between breastfeeding knowledge, self-efficacy and demographic factors on breastfeeding patterns among Hong Kong Chinese primiparous women.	A cross-sectional and correlational design.	A convenience sample of 82 subjects who had normal vaginal delivery in the maternity unit of a regional hospital in Hong Kong	Highest education attained: (1) Primary (2) Secondary (3) Postsecondary	Chinese women who had attained higher education were more likely to practice exclusive breastfeeding. There was a positive association between the level of maternal education and exclusive breastfeeding duration.
Kunwar, Faridi, Singh,	To determine the patterns of breast	Retrospective study	A total of 272 Indian	Educational status of women:	Better education was the only factor significantly affecting

Table 3 (continued)

Author (Date)	Objective	Study Design	Sample	Literacy Measurement	Results
Zahra, & Alizaidi (2010)	feeding, return of menstruation, and contraceptive practices in the first six months postpartum in women visiting the outpatient department at a teaching hospital in Lucknow, Northern India.		mothers were interviewed.	(1) Illiterate (2) Primary (3) Middle (4) High school (5) Intermediate (6) Graduate (7) Postgraduate (8) Professional	exclusively breast-feeding ($p < 0.004$)
Laantera, Pierila, & Poikki (2010)	Describe breastfeeding knowledge of childbearing Finnish parents	Cross sectional analysis using a web-based survey	123 pregnant Finnish mothers and 49 fathers	Highest educational level: (1) Comprehensive school or matriculation (basic education, 9 years) (2) Vocational qualification (general upper secondary school, 3 years) (3) higher vocational diploma or academic	Knowledge scores were poorer among participants with vocational qualifications than participants with academic degrees or higher vocational diplomas (p=0.003).

Table 3 (continued)

Author (Date)	Objective	Study Design	Sample	Literacy Measurement	Results
				degree (University 3-6 years	
Mihrshahi, Kabir, Roy, Agho, Senarath, & Dibley (2010)	To estimate the determinants of selected feeding practices and key indicators of breastfeeding and complementary feeing in Bangladesh.	Retrospective design	2482 children aged 0-23 months from Bangladesh.	Maternal Education: (1)None (2) Primary (3) Secondary or above	A risk factor for an infant not being exclusively breastfed was higher maternal education. The rate of timely initiation of breastfeeding was higher among children of more educated parents. These authors note in their discussion that there is a trend toward more educated mothers being less likely to exclusively breastfeed their babies than less educated mothers.
Memon, Shaikh, Kousar, & Memon (2010)	To assess the practice and knowledge of mothers regarding breast feeding, complimentary feeding, and to find out socio-economic correlates of	A cross sectional survey conducted at paediatric department of Liaquat University Hospital (LUH) in	500 Pakistan women	Education Status: (1)Educated (2) Uneducation	There was a statistically significant difference in feeding practices of educated and uneducated ($P < 0.0001$) Mothers' education and socioeconomic conditions, a positive correlation was noted with feeding practices.

Table 3 (continued)

Author (Date)	Objective	Study Design	Sample	Literacy Measurement	Results
	feeding practices.	Pakistan from Jan-Dec 2008			Complimentary feeding practices did not correlate with any socio-economic indicator except maternal education. Use of bottles was significantly higher among mothers with a low level of education. Of the socio-economic factors, only mothers' education positively correlated with feeding practices.
Niquini, Bittencourt, Lacerda, & Oliveira Leal (2010)	To identify the maternal characteristics and welcoming actions towards mothers of infants aged less than six months associated with early liquid offer.	Cross-sectional study performed in 2007	A representative sample of mothers of infants aged less than six months (n=1,057), users of Primary Health Care (PHC) Units, in the city of Rio de Janeiro,	Level of education: (1)< 8 years (2) 8 or more	Among women with less than eight years of education, those who had not received guidance on breastfeeding in the PHC units after child birth were 1.8 times more likely to offer liquids than those who had not (OR= 1.80; 95% CI: 1.05; 3.09). This positive association between not receiving guidance on breastfeeding after child birth and liquid offer was not observed for women with eight or more years of education.

Table 3 (continued)

Author (Date)	Objective	Study Design	Sample	Literacy Measurement	Results
			Southeastern Brazil.		
Ogunlesi (2010)	To determine the influence of maternal socio-demographic factors on the initiation and exclusivity of breastfeeding	A cross-sectional survey	262 mothers of children aged from 1 to 24 months attending a Nigerian Infant Welfare Clinic was conducted.	Educational qualifications were also recorded as either: (1) High (tertiary, post-secondary, senior secondary) (2) Low (junior secondary, primary and no formal education	Maternal education below secondary level strongly contributed to pre-lacteal feeding (P = 0.004) and failure to practice exclusive breastfeeding (P = 0.008).
Ostlund, Nordstrom, Dykes, & Flacking (2010)	To investigate the duration of breastfeeding and the impact of maternal factors for cessation of breastfeeding in twin infants	Population-based cohort study. Breastfeeding data obtained from Child Health Centres were matched with data on infant and maternal demographics from Swedish	A total of 1.657 twins were included	Data on educational level were obtained from Statistics Sweden, categorized in 2 groups: (1) upper secondary school (2) less and higher education.	In both preterm and term mothers, mothers who had a lower educational level or smoked at first antenatal care visit were subject to earlier cessation of breastfeeding by 6 months of age. In the adjusted logistic regression analysis, in which educational level, maternal age, and smoking were mutually adjusted, the results showed that twins whose mothers had an education level of upper

Table 3 (continued)

Author (Date)	Objective	Study Design	Sample	Literacy Measurement	Results
		national registers.			secondary school or less (OR = 1.97; CI: 1.36-2.86) or whose mothers smoked (OR = 4.09; CI: 2.09-8.01) had a significant risk for cessation of breastfeeding before 6 months.
Pandey, Tiwari, Senarath, Agho, & Dibley (2010)	To estimate infant and young child feeding indicators and the determinant of selected feeding practices.	Retrospective analysis	1906 children between 0-23 months in Nepal	Maternal Education: (1) None (2) Primary (3) Secondary or above	Higher rates of complementary feedings at 6-9 months of age were associated with better education. The rate of exclusively breastfeeding was significantly lower for infants of mothers with secondary or higher education (42%) than for mothers with no education (53%).
Patel, Badhoniya, Khadse, Senarath, Agho, Dibley, et al. (2010)	To estimate infant and young children feeding indicators and determinants of selected feeding practices in India.	Retrospective data analysis	20,108 Indian children aged 0-23 months	Maternal Education: (1)none (2) Primary (3) Secondary or above	The rates of timely initiation of breastfeeding were higher among women who were better educated. (OR for secondary education or above=0.79.)
Sasaki, Ali,	To investigate the	A cross-	312 mothers	Maternal Education”	Cessation of exclusively

Table 3 (continued)

Author (Date)	Objective	Study Design	Sample	Literacy Measurement	Results
Kakimoto, Sarowun, Kanal, & Kuroiwa (2010)	present status of infant feeding practices and identify factors that affect EBF practices during the first 6 months following infant birth in Phnom Penh, Cambodia.	sectional survey with a semistructured questionnaire	with children aged 6 to 24 months in Phnom Penh, Cambodia, from December 2005 to February 2006	(1)< 10 years (2) ≥ 10 years	breastfeeding before 6 months was positively correlated with the following factors: maternal occupation (women who work), lack of paternal attendance at breast-feeding classes, lack of a maternal antenatal exclusively breastfeeding plan, and initiation of breast-feeding later than 30 minutes after birth. In the unadjusted and adjusted models, maternal education was not statistically significant.
Senarath, Dibley, & Agho, (2010)	to examine individual-, household-, and community-level characteristics associated with nonexclusive breastfeeding in infants younger than 6 months of age	Retrospective study using Demographic and Health Surveys data collected between 2002 and 2005 in East and Southeast Asia.	Indonesia (n=5610) Philippines (n=2491) Timor-Leste (n=2166) Vietnam (n=826) Cambodia	Maternal education: (1) No schooling (2) Primary (3) Secondary and above	Poor maternal education in Vietnam and Cambodia were at greater risk for non-exclusive breastfeeding, but not in Timor-Leste, Philippines, or Indonesia. The majority of mothers who had secondary or higher level of education reported lower exclusively breastfeeding rates, and this difference was significant in the Philippines.

Table 3 (continued)

Author (Date)	Objective	Study Design	Sample	Literacy Measurement	Results
			(n=2953)		
Sparud-Lundin, & Wennergren (2010)	To identify predictive factors for initiation and maintenance of breastfeeding with a focus on mothers with type 1diabetes.	Case-control design in Sweden	comparing the outcomes of 108 Swedish mothers with type 1 diabetes with 104 Swedish mothers without diabetes that were matched for parity, gestational, & age.	Educational level: (1) University (2) Secondary school (3) Primary school	Higher education level and breastfeeding at discharge from hospital were predictive factors for breastfeeding at 2 months postpartum in mothers with type 1 diabetes. Independent predictive factors for breastfeeding at 6 months were higher education level.
Tarrant, Fong, Le, Wong, Sham, & Lam (2010)	To describe the breastfeeding and weaning practices of Hong Kong mothers over the infant's first year of life to determine the factors associated	Cross-sectional survey	A cohort of 1417 mother-infant pairs was recruited from the obstetric units of four public hospitals in Hong Kong in the immediate	Maternal Education: (1) Primary (2) compulsory secondary (3) upper secondary (4) University degree	Mothers with higher education, previous breastfeeding experience, who were breastfed themselves and those who were planning to exclusively breastfeed and whose husbands preferred breastfeeding were more likely to continue breastfeeding beyond 1 month. The introduction of infant formula before 1 month and returning to

Table 3 (continued)

Author (Date)	Objective	Study Design	Sample	Literacy Measurement	Results
	with early cessation.		post-partum period and followed prospectively for 12 months or until weaned	(5) Post-graduate degree	work postpartum were predictive of weaning before 3 months. Participants in both the middle education and family income levels had earlier weaning than participants with low and high levels of both education and family income. Mothers with only primary level education had mean breastfeeding duration of 28.4 weeks compared with 13.8 weeks for those with a post-graduate degree.
Wojcicki, Gugig, Tran, Kathiravan, Holbrook, & Heymna (2010)	To assess the frequency of exclusive breastfeeding in the early postpartum period and maternal attitudes towards breastfeeding in a population of mothers at two San Francisco	Cross sectional study	Interviewed 363 California women who had recently delivered a healthy newborn	Maternal education: (1) some college education or less (2) college graduate or higher	Being a college graduate was associated with a decreased risk of formula=mixed feeding (OR 0.28, 95% CI 0.10–0.79). Mothers with more education were also more likely to initiate exclusive breastfeeding.

Table 3 (continued)

Author (Date)	Objective	Study Design	Sample	Literacy Measurement	Results
	hospitals and in relation to WIC participation status.				
Ziol-Guest& Hernandez (2010)	To assesses the association between the timing of prenatal participation in WIC and various infant feeding practices, including breastfeeding initiation, breastfeeding for at least 4 months, exclusive breastfeeding, formula feeding, and early introduction of cow's milk and solid food.	Cross-sectional survey matching of birth certificate data to mothers' interviews 9 months after the child's birth.	A nationally representative sample of 4,450 births in 2001 from the Early Childhood Longitudinal Survey-Birth Cohort	Maternal Characteristics: (1) < high school diploma (2) high school diploma (3) >high school	Findings related to breastfeeding practices suggest that more advantaged mothers (white, married, higher education, and higher incomes) are more likely to initiate breastfeeding and do so for at least 4 months, and exclusively breastfeed. More educated, low-income, married mothers, were more likely to initiate and continue to breastfeed for longer periods than lesser educated, nonmarried counterparts.
Bernardi, Jordao, &	to investigate the weight and length	Cross-sectional	2,857 mothers of newborns	Maternal Schooling (years)	Maternal schooling level influenced breastfeeding. The

Table 3 (continued)

Author (Date)	Objective	Study Design	Sample	Literacy Measurement	Results
Filho, (2009)	of children under two years of age in relation to sociodemographic variables and according to whether they were breastfed.	randomized study conducted in 2004-2005, based on the declaration of live births in Campinas, Brazil	were interviewed and answered a question-naire seeking socio-economic and breastfeeding information	(1) ≤ 4 (2) 5-8 (3) 9-11 (4) ≥12	children whose mothers had education for either smaller (≤ 4 years) or greater numbers of years (≥12 years) received exclusive breastfeeding for longer periods.
deCastro, Engstrom, Cardoso, Damiao, Rito, & Gomes (2009)	To analyze time trend in breast-feeding and exclusive breast-feeding in Brazil.	Data from a monitoring system, based on surveys conducted during the National Immunization Campaign in the city of Rio de Janeiro, Southeastern Brazil, in 1996, 1998, 2000, 2003 and 2006, were analyzed.	Study population was comprised of 19,044 children younger than one year of age, who were present in vaccination stations.	Maternal level of education (completed years of education): (1) <7 (2) 8-10 (3) ≥11	For exclusively breastfeeding <6 months, the disadvantage observed in women with a lower level of education in 1996 was not completely overcome by 2006. A trend of statistically significant increase of exclusively breastfeeding <6months and breastfeeding ≥6 months was found in mothers of all levels of education. Maternal level of education was directly associated with exclusively breastfeeding <6 months, but not with breastfeeding ≥6 months (except in 1996).

Table 3 (continued)

Author (Date)	Objective	Study Design	Sample	Literacy Measurement	Results
Ogbuanu, Probst, Ladita, & Liu (2009)	To study women's self-reported reasons for not initiating breastfeeding and to determine whether these reasons vary by race/ethnicity, and other maternal and hospital support characteristics.	Retrospective Data Analysis	Data are from the 2000–2003 Arkansas PRAMS data restricting the sample to women who did not initiate breastfeeding (n = 2,917)	Maternal education (y) (1) < High school (2) High school (3) >High school	Mothers with a high school education were more likely to cite individual reasons for not initiating breastfeeding than those with greater than high school education (odds ratio [OR], 1.40; 95% confidence interval [CI], 1.04–1.88).
Rakhshani & Mohammadi (2009)	To evaluate duration of breastfeeding and its associated factors in rural and urban children.	Historical cohort study	Health files of 1264 Iranian children who were under 3 years old.	Educational level: (1) illiterate (2) Grade 1—5 (3) Grade 6-8 (4) Grade 9-12 (5) Academic level	Maternal age, mother's job, education level, living area, child's birth weight, child's birth rank, birth intervals, and age of onset of supplementary food had a significant relationship with breastfeeding continuation. The duration of breastfeeding in illiterate mothers was significantly more than others (*P*□0.0001). The least duration of breastfeeding was observed in mothers with an education level higher than

Table 3 (continued)

Author (Date)	Objective	Study Design	Sample	Literacy Measurement	Results
					diploma.
Rebhan, Kohlhuber, Schwegler, Koletzko, & Fromme (2009)	To investigate infant feeding and breast-feeding practices during the first 9 months of life in Bavaria, Germany, in relation to recommendations and to identify factors associated with early feeding of semisolid food.	Prospective cohort study	Data from 3103 infants throughout Bavaria, Germany, were collected in a prospective cohort study	Education, year (1) >11 (2) <10/no degree (3) 10 - 11	A risk factor associated with complementary feeding before the fifth month was low level of education.
Roudbari, Roudbari, & Fazaeli (2009)	to survey the patterns and period of breastfeeding and its associated factors in women.	Cross sectional study	The study was performed in Zahedan, southeast Iran, in 2004–2005, with a sample of 450 mothers	Mother's education: (1) Uneducated (2) Primary & secondary (3) High school (4) Tertiary	Cox regression showed no significant relationship between the level of the mother's education and the period of breastfeeding.

Table 3 (continued)

Author (Date)	Objective	Study Design	Sample	Literacy Measurement	Results
Sisk, Lovelady, Dillard, Gruber, & O'Shea (2009)	To identify maternal and infant characteristics predicting human milk feeding	Cross sectional study	Very low birth weight infants whose mothers (n = 184) participated in a study of lactation counseling and initiated milk expression.	Mothers' educational attainment was obtained from a questionnaire completed by the mother: (1) > 12 years (2) ≤ 12 years	Multivariate logistic regression analysis determined that white race, no perinatal hypertensive disorder, and mechanical ventilation on day of life 3 were marginally significant predictors, and > 12 years of education, intention to breastfeed, female infant, and respiratory distress syndrome were significant predictors for human milk feedings during the first 2 weeks of life.

Table 3 (continued)

Author (Date)	Objective	Study Design	Sample	Literacy Measurement	Results
Skafida (2009)	To examine changes in breastfeeding take-up rates among young children in Scotland and to assess whether maternal education or occupation based social class is stronger and better predictor of breastfeeding take up.	Scotland longitudinal survey	A baby cohort of 5012 singletons born over a 12-month period between June 2004 and May 2005, and a toddler cohort of 2732 singletons born over a 12-month period between June 2002 and May 2003.	Mother's Education: (1) Degree or equivalent (2) Vocational qualifications below degree (3) Higher grade or equivalent (4) Standard grade or equivalent (5) No qualifications (6) Missing	Maternal education was a better and more robust predictor of breast-feeding take-up compared with social class. Mothers with no qualifications resulted as having an 80 % lower chance for the baby cohort, and a 60 % lower chance for the toddler cohort, of initiating breast-feeding compared with those with degrees or equivalent, who were the most likely to initiate breast-feeding. The mothers with vocational qualifications, however, resulted as being less likely to breast-feed than mothers with higher grades or equivalent, despite having achieved more educational qualifications

Table 3 (continued)

Author (Date)	Objective	Study Design	Sample	Literacy Measurement	Results
Webb, Sellen, Ramakrishnan, & Martorell (2009)	To examine associations between maternal academic skills and indicators for the initiation of exclusive breastfeeding and timely introduction of complementary foods	Longitudinal follow-up study in 4 villages of mixed Spanish-Mayan descent, located 40 to 110 km east of Guatemala City, Guatemala.	Infants born to 279 mothers from 4 rural villages in Guatemala from 1996-1999.	Mothers years of schooling: (1) <1 (2) ≥ 1 to ≤ 3 (3) > 3 to ≤ 6 (4) > 6	Compared with mothers with < 1 year of school, mothers with > 3 to ≤ 6 years had greater odds of initiating exclusive breastfeeding; Mothers with > 6 years of school had greater odds of introducing complementary feedings early, while mothers with ≥ 1 to ≤ 3 years had greater odds of introducing complementary feedings late.
Van Rossem, Onema, Steegers, Moll, Jaddoe, & Hofman, et al. (2009)	To assess the effect of a woman's educational level on starting and continuing breastfeeding and to assess the role of socio-demographic, lifestyle-related, psychosocial, and birthcharacteristic in this association.	Population-based prospective cohort study.	Data of 2914 participants in Helsinki, Netherlands	Maternal Educational Level: (1) low: no education, or primary school: 3 years of general secondary school (2) midlow: 3 years of general secondary school (3) midhigh: higher vocational training,	Educationally related differences were present in starting breastfeeding and the continuation of breastfeeding until 2 months but not in breastfeeding continuation between 2 and 6 months The decision to breastfeed is affected by a mother's educational background. Mothers in the lowest educational group were less likely to breastfeed (73%), whereas 95.5% of the mothers in the highest educational group

Table 3 (continued)

Author (Date)	Objective	Study Design	Sample	Literacy Measurement	Results
				under-graduate programs, or bachelor's degree) (4) high: higher academic education)	breastfed. Of the mothers that began breastfeeding, the ones in the lowest education group (15%) were less likely to still be breastfeeding at six months as compared to the mothers in the highest education group (39%).
Barria, Santander, Victoriano, & (2008)	To identify variables significantly associated with exclusive breastfeeding.	A prospective cohort study	315 mother-newborns from Valdivia, Chile.	The mother's educational level was categorized in the following levels: (1) primary (up to 8 years of study) (2) secondary (9-12 years) (3) superior (more than 12 years).	Maternal education > 8 years was associated with continuation of exclusive breastfeeding at 3 months of age (OR, 0.45; 95% CI, 0.24-0.84).
Black, Godwin, & Ponka (2008)	To determine the Characteristics of low breastfeeding rates in Ontario between 1997-2003.	Retrospective medical chart review of women who had given birth	Women who gave birth in a hospital in Ontario.	Education level: (1) Post secondary (2) Finished high school	Low educational status was a risk factor for a mother choosing not to breastfeed in univariate chi-square analysis. Using logistic regression, only 3

Table 3 (continued)

Author (Date)	Objective	Study Design	Sample	Literacy Measurement	Results
				(3) Some high school (4) Elementary school	variables remained in the model as independently associated with breastfeeding—one of which was < post-secondary education
Chin, Myers, & Magnus (2008)	To examine the independent effects of race and education on breastfeeding initiation To determine whether the interaction effect between race and education on breastfeeding initiation To determine whether factors associated with breastfeeding initiation were different depending on the	Retrospective data analysis using 2000-2004 Louisiana PRAMS data	A total of 3515 women from Louisiana (1373 black 2142 white)	Education: (1) < 12 years (2) 12 years (3) 13+ years	Significant differences between black as well as white women breastfeeding initiators and non-initiators were found for maternal age, education, household income, marital status, receipt of Medicaid before pregnancy, and WIC participation during pregnancy in bivariate analysis. Women with some college were more than 4 times more likely to breastfeed than those with < high school education (odds ratio [OR] = 4.28; 95% confidence interval [CI]: 3.03, 6.04). An interaction between race and education was not found to be significant after adjusting for the other variables in the model After stratifying the sample by race, greater maternal education

Table 3 (continued)

Author (Date)	Objective	Study Design	Sample	Literacy Measurement	Results
	race of the mother.				was significantly associated with breastfeeding initiation among white women. Women with 12 years of education were almost twice as likely to initiate breastfeeding as women <12 years of education (adjusted OR = 1.86; 95% CI: 1.21, 2.88), and those with 13 or more years of education were more than 4 times more likely to initiate breastfeeding compared with those < 12 years (adjusted OR = 4.28; 95% CI: 2.74, 6.69).
Aryal (2007)	To investigate the determinants of breastfeeding according to the characteristics of mother and her child.	Cross sectional study design	1019 mothers from Palpa and Rupandehi districts in Nepal conducted in 2000.	Education of mothers: (1) Illiterate (2) Literacy and primary (3) Mid-high school (4) Inner and more	The coefficients of mothers' education categories were found to be statistically significant. It was found that the increased risk of terminating breastfeeding was found with increased level of mothers' education. 2.8 times higher risk of terminating breastfeeding was found for mothers who have intermediate and higher education

Table 3 (continued)

Author (Date)	Objective	Study Design	Sample	Literacy Measurement	Results
					as compared to uneducated counter-parts. 1.4 times higher risk of terminating breastfeeding was found for mothers who have middle and high school level education compared to uneducated counter-parts. Mother's age, their education and socio-economic standing were the main predictors of the timing of breastfeeding.
Flacking, & NyqvistEwald (2007)	To investigate the impact of socioeconomic status on breastfeeding duration in mothers of preterm and term infants.	Prospective population based cohort study in Sweden.	55, 672 infants of 38, 893 mothers were obtained at the Medical Birth Registry in Sweden.	Maternal educational Level: (1) Compulsory school or less (2) Upper secondary school (3) Higher education	Low educational attainment affects the duration of breastfeeding of both pre-term and full-term infants. Lower maternal education, unemployment benefit received by the mother, social welfare in the household, was all independently negatively associated with breastfeeding at 6 months.
Lessen &	To describe	Multiphase	100 Women	Education:	Women who had some college or

Table 3 (continued)

Author (Date)	**Objective**	**Study Design**	**Sample**	**Literacy Measurement**	**Results**
Crivelli-Kovach (2007)	maternal, neonatal, and outside influences associated with the intention, initiation, and duration of breastfeeding.	design	whose infant was admitted to neonatal intensive care unit (NICU)	(1)<high school (2) High school (3) Some college (4) College graduate (5) Postgraduate	graduate education were more likely to make the decision to exclusively breastfeed. Survival analysis found that women with a postgraduate education level had a longer duration of breastfeeding.

Table 4: Previous Research on Education and Infant Sleep Position: 2000-2011

Author (date)	**Objective**	**Study Design**	**Sample**	**Literacy Measurement**	**Results**
Lung, & Su (2011)	To explore the multiple pathways and recursive or non-recursive relationships among social demographics, parental smoking, acute hospital admission, supine position and child development from 6 to 36 months of age.	Longitudional, developmental study at 6 months, 18 months, 36 months	1680 families All babies born between October 2003 and January 2004 in Taiwan	Maternal education: (1) None (2) Elementary school (3) High school (4) University/ college (5) Graduate school	With potential confounding factors controlled, children six-months old of mothers with a lower level of education tended to sleep supine (p. =0.001). In this study, maternal level of education was the only factor found to influence the placement of infants, with less-educated mothers more likely to place their infants in the supine position.

Table 4 (continued)

Author (date)	Objective	Study Design	Sample	Literacy Measurement	Results
Colson, Rybin, Smith, Colton, Lister, Corwin, (2009)	To determine trends and factors associated with choice of infant sleeping position.	Annual nationally represent-ative telephone surveys from 1993 through 2007	Forty-eight U.S. states. Nighttime caregivers of infants born within 7 months.	Mother's education: (1) up to college (2) college or more	Factors associated with increased supine sleep between 1993 and 2007 included time, maternal race other than African American, higher maternal educational level, not living in Southern states, first-born infant, and full-term infant.
Anuntaseree, Mo-suwan, Vasiknanont Kuasirikul, Ma-a-lee, Choprapawon (2008)	To study bed sharing and sleep position in Thai neonates and the relationship to infant and maternal characteristics.	cross-sectional survey Interviews Were conducted under the Prospective Cohort Study of Thai Children.	3692 parents of infants aged 21 days old	Education: (1) $\leq 6^{th}$ grade (2) $> 6^{th}$ grade	Placing the infants to sleep in a prone (face down) position was associated with older maternal age & higher education
McKinney, Holt, V.Cunningham, Leroux,	To identify factors predictive of either lateral or prone infant sleep	Retrospective, secondary analysis from the Pregnancy Risk Assessment	11,340 mother-infant pairs	Mother's education (in years): (1) < 12	Mothers with 12 years of education more commonly placed their infants

Table 4 (continued)

Author (date)	Objective	Study Design	Sample	Literacy Measurement	Results
Starr (2008)	positioning.	Monitoring System for infants born in Washington State, 1996 to 2002.		(2) 12 (3) 13-14 (4) ≥ 15	to sleep lateral (side position) than mothers with ≥ 15 years of education. Markers of low socioeconomic status were common in infants placed lateral to sleep, including single marital status, low maternal education, and being from a low-income household. These results imply that there could be little additional gain in targeting interventions on the basis of education or marital status in addition to interventions targeted toward specific racial or

Table 4 (continued)

Author (date)	Objective	Study Design	Sample	Literacy Measurement	Results
					ethnocultural groups.
Moon, Calabrese, Aird, (2008)	To evaluate, through an American Academy of Pediatrics demonstration project, the effectiveness of a curriculum and train-the-trainer model in changing child care providers' behaviors regarding safe infant sleep practices.	Cross-sectional design	1212 caregivers of 1993 infants	(1) at least a high school diploma (92%) (2) 4-year college degrees.	Child care providers (gender unidentified) were more likely to doubt or not to believe the benefits of supine positioning if they were black ($P < .01$), if they had less education ($P < .001$), or the majority of children cared for were black.
Kemp, Harris, Chavez, (2006)	To assess levels of maternal knowledge of SIDS prevention strategies in a socio-economically disadvantaged, culturally diverse population.	Cross sectional study	233 Australian Pregnant women	Level of education: (1) School only (2) Vocational (3) Professional	SIDS knowledge was related to level of education & maternal age. Year of arrival in Australia, number of previous children, age, and

Table 4 (continued)

Author (date)	Objective	Study Design	Sample	Literacy Measurement	Results
					level of education were not significantly related to women's knowledge. Knowledge of SIDS prevention strategies was not significantly related overall to level of education for either the Australian- or overseas-born group (overseas-born women $P = 0.12$; Australian-born $P = 0.10$)

Table 4 (continued)

Author (date)	Objective	Study Design	Sample	Literacy Measurement	Results
Pickett, Lauderdale, (2005)	The objective was to see whether the "Back to Sleep" campaign has reduced social class (mother's educational level) inequalities in SIDS.	Population-based case-cohort study during 2 periods, 1989 to 1991 and 1996 to 1998, using the US Linked Birth/Infant Death Data	Case group was infants who died of SIDS in infancy (N=21,126); control group was a 10% random sample of infants who lived through the first year and all infants who died of other causes (N=2,241,218).	Mother's highest level of educational attainment was used as a measure of social class. Mothers were categorized as having either: (1) No education or only elementary education (0–8 years), (2) Some high school (9–11 years), (3) Graduated high school (12 years), (4) Some college education (13–15 years), (5) Graduated from college or beyond (16+ years).	Odds Ratio for SIDS associated with lower educational attainment increased between 1989–1991 and 1996–1998. Within each period, lower levels of maternal education were associated with higher risk of SIDS versus an infant surviving the first year. Maternal education did not narrow after the 'Back to Sleep' campaign compared with the Pre-campaign era.

Table 4 (continued)

Author (date)	Objective	Study Design	Sample	Literacy Measurement	Results
Moon, Oden, Grady, (2004)	To determine whether a 15-minute educational intervention is effective in changing sleep position practice among black parents.	Pre-post educational intervention	310 parents/ caregivers participated in sessions from October 2001 to July 2002	Patient educational attainment: (1) Did not finish high school (2) High school graduate (3) Some college or technical school (4) Technical school graduate (5) 4-year college graduate (6) Postgraduate training (7) Unknown	Infants were more likely to be placed supine when previous children were placed supine or when parents had more than a high school education.
Phares, Morrow, Lansky, Barfield, Prince, Marchi,	To analyze data concerning four maternal behaviors for which Healthy People 2010 objectives exist:	Cross sectional study of maternal women from Alabama, Colorado, Florida, Hawaii, Illinois,	Random sample of women in 8 states who have had a live birth in 2000 and 2001.	Maternal education was categorized as: (1) < high school (<12 years)	Use of the back sleep position was lowest among younger women, black women, women with lower

Table 4 (continued)

Author (date)	Objective	Study Design	Sample	Literacy Measurement	Results
& et al. (2004)	smoking use during pregnancy, alcohol use during pregnancy, breastfeeding initiation, and placing infants in the back sleep position.	Maine, Nebraska, and North Carolina		(2) high school (12 years) (3) >high school (>12 years).	levels of education, and women with low incomes. Among all eight states, use of the back sleep position was lowest among younger women, black women, women with lower levels of education, and women with low incomes; ethnic differences in sleep position varied by state. In three states (Alabama, Florida, and North Carolina), women of all education levels did not achieve the Healthy People 2010 target for the back sleep position.

Table 4 (continued)

Author (date)	Objective	Study Design	Sample	Literacy Measurement	Results
					In all states, use of the back sleep position increased with higher education level. Women with >12 years of education were consistently more likely than women with less education to breastfeed their children, use the back sleep position for infants, and abstain from smoking.
Chung, Hung, Marchi, Chavez, Braveman, (2003)	To determine the maternal and infant characteristics associated with the back sleep position for infants to guide efforts to increase its use and reduce the risk of SIDS.	Cross-sectional survey	3,349 mothers delivering in California, February–May 1999.	Education, highest level completed: (1) ≤ 8th grade (2) Some high school (3) High	Factors associated with a lower likelihood of using the back position included all levels of maternal education less than college, income at or below

Table 4 (continued)

Author (date)	Objective	Study Design	Sample	Literacy Measurement	Results
				school/GED (4) Some college College or more	federal poverty level, multiparity, Race/ethnicity African American & Asian/Pacific Islander, speaking a non-English language, and infant age over 7 months.
Corwin, Lesko, Heeren, Vezina, Hunt, Mandell, et al. (2003)	To compare factors associated with sleep position in 1995–1996 and 1997–1998 and to assess secular trends in the use of prone infant sleep position from 1995 through 1998 among families according to race and education.	Prospective cohort study conducted in eastern Massachusetts & northwest Ohio	12,029 mothers of infants who weighed >2500 g at birth.	Maternal Education: (1)< High school (2) High school graduate (3) Some college (4) College graduate	Factors associated with prone and supine sleep position were similar in 1995–1996 and 1997–1998. In 1997–1998, use of prone sleeping at 1 month of age reached the goal of <10% only among infants of white and Asian women, married women,

Table 4 (continued)

Author (date)	Objective	Study Design	Sample	Literacy Measurement	Results
					women who were older than 25 years, women who were college graduates, and women with incomes >$55 000 per year. The factors associated with increased risk of prone sleeping and decreased likelihood of supine position did not change substantially between 1995 and 1998, suggesting that in 1997–1998, sleep position recommendations continued to be less effective among black and Hispanic families and families of low income and mothers with less than a

Table 4 (continued)

Author (date)	Objective	Study Design	Sample	Literacy Measurement	Results
					college education.
Froen, Arnestad, Vege, Irgens, Rognum, Saugstad, & et al. (2002)	To test the hypothesis that SIDS and sudden intrauterine (SIUDS) unexplained death have common risk factors.	Retrospective study from 1986-1995 in Oslo, Norway	76 cases of SIUD, 78 of SIDS. & 582 random controls surviving infancy, all singletons	Education: (1)<10 years (2)10-12 (3)>12 years	SUID was associated with high maternal age, overweight/obesity, smoking, and low education. Low education (<10 years) of the mother was much more common in cases of SIDS than in controls (surviving infancy, singletons). However, maternal educational level lost its significance in the multiple model because low education was significantly ($p < 0.005$) positively correlated with maternal smoking, low

Table 4 (continued)

Author (date)	Objective	Study Design	Sample	Literacy Measurement	Results
					maternal age, & higher parity.
Pollack, Frohna, (2002)	To examine changes in infant sleep position from 1996-1998 in a large population based sample.	Epidemiologic study between the years 1996-1998 in 15 states.	55,263 mothers who have had a live birth	Education: (1) No high school diploma (2) High school graduate (3) College graduate	Maternal education, maternal age and marital status, and infant birth weight had only a small impact on the likelihood of prone sleeping. Maternal educational level was a small, though statistically significant predictor of supine sleeping.
Willinger, Ko, Hoffman, Kessler, Corwin, (2000)	To examine sociodemographic characteristics, motivation, and message exposure to ascertain which factors influenced a caregiver's choice of infant sleep	National Infant Sleep Position study (NISP) Telephone interviews in 48 contiguous states This study	Nighttime caregivers of infants born within the 7 months prior to interview between 1994 and 1998.	Education, y (1) <12 (2) 12 (3) 13-15 (3) $\geq$ 16	In multivariate analysis, physician recommendation of "supine not prone" had the strongest influence & was associated with: increased supine placement.

Table 4 (continued)

Author (date)	Objective	Study Design	Sample	Literacy Measurement	Results
	position after implementation of the campaign	oversamples mothers with < high school education			Recommendations from all 4 sources (the physician, neonatal nurse, reading materials, and radio/television) further increased the probability of supine placement. Education was not a significant factor for either prone or supine position.

Table 5: Dependent Variables, Knowledge and Behavior Survey Questions from Phase 3 (1997-1998-1999) and Phase 5 (2005-2007-2008) PRAMS Data

Dependent Variable	**Survey Question Phase 3 (1997-1998-1999)**	**Survey Question Phase 5 (2005-2007-2008)**
Folic Acid Consumption		
Knowledge	# 20 Have you ever heard or read that taking the vitamin folic acid help prevent some birth defects? ___No ___Yes	# 23 Have you ever heard or read that taking the vitamin folic acid can help prevent some birth defects? ___No ___Yes
Behavior	# 53 Before you knew you were pregnant, how frequently did you take either vitamins containing folic acid or multivitamins? Check only one. ___I took them every day ___I took them, but not every day ___I did not take them at all	# 3 During the months before you got pregnant with your new baby, how many times a week did you take a multivitamin or a prenatal vitamin? These are pills that contain many different vitamins and minerals. ___I didn't take a multivitamin or a prenatal vitamin at all ___1 to 3 times a week ___ 4 to 6 times a week ___Every day of the week
Infant Breastfeeding		
Knowledge	# 16c During any of your prenatal care visits, did a doctor, nurse, or other health care worker talk with you about any of the things listed below? For each thing, please circle Y (yes) if someone talked with you about it or circle N (no) if no one talked with you about it. c. Breast-feeding your baby __No __Yes	# 21b During any of your prenatal care visits, did a doctor, nurse, or other health care worker talk with you about any of the things listed below? Please count only discussions, not reading materials or videos. For each item, circle Y (yes) if someone talked with you about it or circle N (no) if no one talked with you about it. b. Breastfeeding my baby __No __Yes

Table 5 (continued)

Dependent Variable	**Survey Question Phase 3 (1997-1998-1999)**	**Survey Question Phase 5 (2005-2007-2008)**
Behavior	# 42 For how many weeks did you breast-feed your new baby? ____weeks ___I didn't breast-feed my baby ___I breast-fed less than 1 week ___I'm still breast-feeding	# 49 Did you ever breastfeed or pump breast milk to feed your new baby after delivery? ___No ___Yes
Infant Sleep Position		
Knowledge	#54d At any time during prenatal care, did a doctor, nurse, or other health care worker talk with you about any of the following? For each thing, circle Y (yes) if someone talked with you about it or N (no) if no one talked with you about it. d. Placing your baby to sleep on his or her back or side __No __Yes	# 65c During any of your prenatal care visits, did a doctor, nurse, or other health care worker talk to you about any of the things listed below? For each item, circle Y (yes) if someone talked to you about it or circle N (no) if no one talked to you about it. c. Placing your baby to sleep on his or her back or side __No __Yes
Behavior	# 45 How do you put your new baby down to sleep most of the time? Check one answer. ___On his or her side ___On his or her back ___On his or her stomach	# 56 How do you most often lay your baby down to sleep now? ___On his or her side ___On his or her back ___On his or her stomach

Table 6: Main Variable of Interest and Covariates with Corresponding Phase 3 (1997-1998-1999) and Phase 5 (2005-2007-2008) PRAMS Survey Questions

Independent Variables	Rationale for Confounding	Survey Question Phase 3 (1997-1998-1999)	Survey Question Phase 5 (2005-2007-2008)
Socioeconomic Factors			
Educational Attainment	Main variable of interest	Birth Certificate Grades: $\leq 8^{th}$ 9^{th}-11^{th} 12^{th} 13^{th} -15^{th} $\geq 16^{th}$	Birth Certificate Grades: $\leq 8^{th}$ 9^{th}-11^{th} 12^{th} 13^{th} -15^{th} $\geq 16^{th}$
Race	Race influences knowledge and behaviors	Birth Certificate Race: White African American American Indian Chinese Japanese Hawaiian Filipino Other Asian Unknown	Birth Certificate Race: Other Asian White Black American Indian Chinese Japanese Hawaiian Other non-white Alaska Native Mixed
Hispanic	Ethnicity influences knowledge and behaviors	Birth Certificate ___Yes ____No	Birth Certificate ___Yes ____No
Age	Age influences knowledge and behaviors	Birth Certificate Continuous variable	Birth Certificate Continuous variable
Marital Status	Father's influence knowledge and behaviors	Birth Certificate ___No ___Yes	Birth Certificate ___No ___Yes

Table 6 (continued)

Independent Variables	**Rationale for Confounding**	**Survey Question Phase 3 (1997-1998-1999)**	**Survey Question Phase 5 (2005-2007-2008)**
Parity (Previous live birth)	Previous knowledge and behaviors	#1 Before your new baby, did you ever have any other babies who were born alive? ___No ___Yes	#8 Before you got pregnant with your new baby, did you ever have any other babies who were born alive? ___No ___Yes
Non-Medicaid Insurance	Access to healthcare and health information	# 6 Just before you got pregnant, did you have health insurance? Don’t count Medicaid. ___No ___Yes	# 1 Just before you got pregnant, did you have health insurance? ___No ___Yes
Medicaid		# 7 Just before you got pregnant, were you on Medicaid? ___No ___Yes	# 2 Just before you got pregnant, were you on Medicaid? ___No ___Yes

Table 6 (continued)

Independent Variables	Rationale for Confounding	Survey Question Phase 3 (1997-1998-1999)	Survey Question Phase 5 (2005-2007-2008)
Income	Access to healthcare and health information	#70 In the 12 months before your most recent delivery, what was your total family income before taxes? Include your income, your husband's or partner's income, and any other income that you may had had. Your answer will not affect your eligibility for any services you are not getting. $7,999 or less $8,000 to $9,999 $10,000 to $11,999 $12,000 to $13,999 $14,000 to $15,999 $16,000 to $17,999 $18,000 to $19,999 $20,000 to $24,999 $25,000 to $29,999 $30,000 to $39,999 $40,000 to $49,999 $50,000 or more	#63 During the *12 months before* your new baby was born what was your total household income before taxes? Include your income, your husband's income, or partner's income, and any other income you may have used. (All information will be kept private and will not affect any services you are now getting.) Less than $10,000 $10,000 to $14,999 $15,000-$19,999 $20,000-$24,999 $25,000-$29,999 $35,999-$49,999 $50,000 or more
Psychological Factors			
Planned Pregnancy	Mothers that plan a pregnancy are interested in having a healthy pregnancy and infant. Mothers are also	# 5 Thinking back to just before you got pregnant, how did you feel about becoming pregnant? Check the best answer.	# 11 Thinking back to just before you got pregnant with your new baby, how did you feel about becoming pregnant? Check one answer

Table 6 (continued)

Independent Variables	Rationale for Confounding	Survey Question Phase 3 (1997-1998-1999)	Survey Question Phase 5 (2005-2007-2008)
	more likely to get early pre-natal care and learn more about acceptable behaviors while pregnant	___I wanted to be pregnant sooner ___I wanted to be pregnant later ___I wanted to be pregnant then ___I didn't want to be pregnant then or at any time in the future ___I don't know	___I wanted to be pregnant sooner ___I wanted to be pregnant later ___I wanted to be pregnant then ___I didn't want to be pregnant then or at any time in the future
Prenatal Stress (difficult time)	Exposure to stress increases the stress hormone, cortisol and can lead to illness, depression, and/or exhaustion. Indicates poor health including high blood pressure, heart disease and ulcers. A maternal woman exposed to stress may not be able to care for her baby adequately even if she has the correct knowledge.	#68 How would you describe the time during your pregnancy? Check the best answer. ___One of the happiest times of my life ___A happy time with few problems ___A moderately hard time ___A very hard time ___One of the worst times of my life	# 39 How would you describe the time during your most recent pregnancy? ___One of the happiest times of my life ___A happy time with few problems ___A moderately hard time ___A very hard time ___One of the worst times of my life
Postpartum Depression	Mother may be unable to properly care for her infant and/or may be on medications affecting her ability to properly care for her infant.	#69 In the months after your delivery, would you say that you were--- Check the best answer. ___Not depressed at all ___A little depressed	# 73a Since your new baby was born, how often have you felt down, depressed, or hopeless? ___Always ___Often ___Sometimes ___Rarely ___Never

Table 6 (continued)

Independent Variables	Rationale for Confounding	Survey Question Phase 3 (1997-1998-1999)	Survey Question Phase 5 (2005-2007-2008)
		___Moderately depressed ___Very depressed ___Very depressed and had to get help	
Birth Characteristics			
Multiple Births	Mother may be unable to care for herself or infant the same.	Birth Certificate ___single ___twin ___other multiple	Birth Certificate ___single ___twin ___other multiple
Baby in Intensive Care	Separation	# 39 When your baby was born, was he or she put in an intensive care unit? ___No ___Yes ___I don’t know	# 45 After your baby was born was he or she put in an intensive care unit? ___No ___Yes ___I don’t know

Table 7: Unweighted and Weighted Descriptive Analyses of all Variables for Phase 3 (1997-1998-1999) of the NC PRAMS Data: Stratified by Educational Attainment Level

	≤ 8th Grade		**9th-11th Grade**		**12th Grade**		**13th-15th Grade**		**≥ 16th Grade**	
	N[1]	W[2](%)[3]	N	W(%)	N	W(%)	N	W(%)	N	W(%)
Folic Acid Maternal Knowledge										
Yes	97	8248(3.06)	428	26139(9.69)	1002	62359(23.12)	802	51242(19.00)	891	56428(20.92)
No	96	6413(2.38)	328	19731(7.31)	470	25112(9.31)	201	10362(3.84)	68	3725(1.38)
Total	193	14661(5.44)	756	45870(17.00)	1472	87471(32.43)	1003	61604(22.84)	959	60153(22.30)
Folic Acid Maternal Behavior										
Yes	63	5682(2.09)	209	14320(5.27)	528	32127(11.83)	522	32986(12.14)	685	42305(15.58)
No	132	9146(3.37)	553	32271(11.88)	949	55791(20.54)	489	29168(10.74)	270	17753(6.54)
Total	195	14828(5.46)	762	46591(17.15)	1477	87918(32.37)	1011	62154(22.88)	955	60058(22.12)
Breastfeeding Maternal Knowledge										
Yes	164	13283(4.94)	671	41956(15.61)	1290	78828(29.33)	862	55024(20.48)	792	50963(18.96)
No	19	932(0.35)	62	3435(1.28)	157	8252(3.07)	127	6784 (2.52)	167	9279(3.45)
Total	183	14215(5.29)	733	45391(16.89)	1447	87080(32.40)	989	61808(23.00)	959	60242(22.41)
Breastfeeding Maternal Behavior										
Yes	51	4858(2.59)	92	7373(3.93)	273	19686(10.50)	317	23785(12.68)	474	32725(17.45)
No	79	5515(2.94)	418	26594(14.18)	653	41023(21.88)	275	16972(9.05)	130	8983(4.79)
Total	130	10373(5.53)	510	33967(18.11)	926	60709(32.38)	592	40757(21.73)	604	41708(22.24)
Infant Sleep Position Maternal Knowledge										
Yes	154	12422(4.68)	641	40529(15.27)	1193	74504(28.09)	824	53491(20.16)	775	50390(19.00)
No	25	1314(0.50)	86	4499(1.70)	230	10629(4.00)	162	8264(3.12)	171	9299(3.47)
Total	179	13736(5.18)	727	45028(16.97)	1423	85133(32.09)	986	61755(23.28)	946	59689(22.47)
Infant Sleep Position Maternal Behavior										
Yes	60	4873(1.91)	251	16895(6.62)	562	38932(15.24)	415	27436(10.74)	493	33584(13.15)
No	100	8137(3.18)	394	25028(9.80)	727	43941(17.21)	485	31634(12.39)	389	24925(9.76)
Total	160	13010(5.09)	645	41923(16.42)	1289	82873(32.45)	900	59070(23.13)	882	58509(22.91)
Age[4]										
18-24	76	6520(2.39)	386	25078(9.18)	736	44443(16.27)	327	18846(6.90)	53	3310(1.21)
25-32	47	4272(1.56)	111	6764(2.48)	509	29882(10.94)	454	30156(11.04)	444	27824(10.18)

Table 7 (continued)

	≤ 8th Grade		**9th-11th Grade**		**12th Grade**		**13th-15th Grade**		**≥ 16th Grade**	
	N[1]	W[2](%)[3]	N	W(%)	N	W(%)	N	W(%)	N	W(%)
33-39	13	817(0.30)	60	2362(0.86)	204	12039(4.41)	210	12411(4.54)	439	28087(10.28)
≥40	1	13(0.00)	4	173(0.06)	16	777(0.28)	23	1045(0.38)	28	1478(0.54)
Total	137	11622(4.25)	561	34377(12.58)	1465	87141(31.90)	1014	62458(22.86)	964	60699(22.21)
Race										
Non-Hispanic White	151	12685(4.64)	417	28401(10.39)	893	58772(21.51)	681	44142(16.16)	801	52056(19.05)
Non-Hispanic Black	37	2115(0.77)	309	15911(5.82)	540	26093(9.55)	305	16908(6.19)	131	6347(2.32)
American Indian	7	241(0.09)	29	1386(0.51)	26	1440(0.53)	16	931(0.34)	7	527(0.19)
Asian	2	113(0.04)	11	923(0.34)	25	1885(0.73)	12	371(0.18)	24	1193(0.61)
Total	197	15267(5.54)	766	46621(17.06)	1483	88190(32.10)	1012	62352(22.87)	959	60123(22.17)
Ethnicity										
Hispanic										
Yes	83	8477(3.10)	47	4055(1.48)	57	4249(1.56)	22	1233(0.45)	12	510(0.19)
No	114	6677(2.44)	719	42566(15.58)	1427	84054(30.77)	991	61117(22.38)	952	60188(22.04)
Total	197	8477(5.55)	766	46621(17.07)	1484	88303(32.33)	1013	62350(22.83)	964	60698(22.23)
Income										
< $10,000	73	5453(2.00)	309	19585(7.17)	334	17395(6.95)	91	4213(1.69)	16	343(0.25)
$10,000-24,999	43	4185(1.53)	247	14993(5.49)	548	32208(12.88)	291	22035(8.82)	61	1200(1.26)
$25,000-49,999	9	795(0.29)	69	5033(1.84)	381	24735(9.89)	365	23436(9.37)	234	2086(6.31)
≥$50,000	5	41(0.02)	10	701(0.26)	110	6717(2.68)	220	14222(5.68)	621	1818(15.43)

Table 7 (continued)

	≤ 8th Grade		9th-11th Grade		12th Grade		13th-15th Grade		≥ 16th Grade	
	N[1]	W[2](%)[3]	N	W(%)	N	W(%)	N	W(%)	N	W(%)
Total	130	10471(4.20)	635	40312(14.76)	1087	81064(34.40)	967	63907(24.15)	932	58289(23.25)
Married										
Yes	72	6218(2.28)	245	15296(5.60)	883	55244(20.22)	784	50365(18.43)	912	57978(21.22)
No	125	8936(3.27)	521	31324(11.46)	601	33059(12.10)	230	12092(4.43)	52	2722(1.00)
Total	197	15154(5.55)	766	46620(17.06)	1484	88303(32.32)	1014	62457(22.86)	964	60700(22.22)
Other Children										
Yes	106	9507(3.50)	350	21606(9.00)	811	52620(19.43)	525	34820(12.86)	441	31125(11.49)
No	85	5438(2.00)	405	24388(7.98)	655	39419(12.89)	489	27123(10.01)	523	29574(10.82)
Total	191	14945(5.50)	755	45994(16.98)	1466	90239(32.32)	1014	61943(22.87)	964	60699(22.231
Single Birth										
Yes	189	15055(5.50)	729	46225(16.92)	1394	86997(31.84)	945	61481(22.50)	877	59583(21.81)
No	8	99(0.04)	37	395(0.14)	90	1305(0.48)	69	977(0.36)	87	1117(0.41)
Total	197	15154(5.54)	766	46620(17.06)	1484	88302(32.32)	1014	62458(22.86)	964	60700(22.22)
Non-Medicaid Insurance										
Yes	29	1570(0.58)	211	12832(4.72)	807	49463(18.19)	749	46990(17.29)	912	57973(21.33)
No	164	13099(4.82)	549	33417(12.29)	677	38841(14.13)	264	15367(5.65)	51	2717(1.00)
Total	193	14669(5.40)	760	46249(17.01)	1484	88304(32.32)	1013	62357(22.94)	963	60690(22.33)
Medicaid										
Yes	61	3844(1.41)	252	13630(5.00)	202	10396(3.81)	62	3602(1.32)	11	400(0.15)
No	135	11161(4.09)	514	32991(12.09)	1279	77708(28.49)	951	58755(21.54)	952	60290(22.10)
Total	196	15005(5.50)	766	46621(17.09)	1481	88104(32.30)	1013	62357(22.86)	963	60690(22.25)
Planned Pregnancy										
Yes	92	7679(3.01)	238	13671(5.35)	675	3953(15.48)	565	34852(13.64)	719	44439(17.40)
No	83	6029(2.36)	462	29199(11.43)	706	42187(16.51)	383	23441(9.17)	207	14366(5.62)
Total	175	13708(5.37)	700	42870(16.78)	1381	46140(31.99)	948	58293(22.81)	926	58805(23.02)
Stress										
Yes	37	1951(0.73)	229	11915(4.46)	454	23645(8.85)	284	14129(5.29)	223	10991(4.11)

Table 7 (continued)

	≤ 8th Grade		9th-11th Grade		12th Grade		13th-15th Grade		≥ 16th Grade	
	N[1]	W[2](%)[3]	N	W(%)	N	W(%)	N	W(%)	N	W(%)
No	149	12152(4.55)	507	32965(12.34)	1002	62967(23.57)	718	47511(17.79)	727	48869(18.30)
Total	186	14103(5.28)	736	44880(16.80)	1456	86612(31.42)	1002	61640(23.08)	950	59860(22.41)
Depression										
Yes	43	2047(0.76)	232	11727(4.34)	408	18834(6.96)	261	11721(4.33)	185	8309(3.07)
No	144	12421(4.59)	522	34485(12.74)	1065	68747(25.40)	742	50370(18.61)	772	51970(19.20)
Total	187	14468(5.35)	754	46212(17.08)	1473	87581(32.36)	1003	62091(22.94)	957	60279(22.27)
Intensive Care Unit (ICU)										
Yes	65	2610(0.97)	259	4997(1.86)	516	9564(3.56)	305	5781(2.15)	264	4631(1.73)
No	118	11057(4.12)	478	39904(14.87)	942	77607(28.93)	699	56319(20.99)	695	55830(20.81)
Total	183	13667(5.09)	737	44901(16.73)	1458	87171(32.49)	1004	62100(23.14)	959	60461(22.54)

Note: [1]N= refers to the unweighted sample size.
[2]W=weighted totals.
[3]Percentages may not equal 100% due to rounding.
[4]Teenagers=n=284 w=4428 (6.41%).

Table 8: Unweighted and Weighted Descriptive Analyses of all Variables for Phase 5 (2005-2007-2008) of the NC PRAMS Data: Stratified by Educational Attainment Level

	≤ 8th Grade		**9th-11th Grade**		**12th Grade**		**13th-15th Grade**		**≥ 16th Grade**	
	N[1]	W[2](%)[3]	N	W(%)	N	W(%)	N	W(%)	N	W(%)
Folic Acid Maternal Knowledge										
Yes	159	16448(4.99)	424	39012(11.83)	862	70065(21.25)	795	60562(18.37)	1150	90503(27.45)
No	41	3950(1.20)	176	15014(4.55)	255	19674(5.97)	122	10244(3.11)	52	4230(1.28)
Total	200	20398(6.19)	600	54026(16.38)	1117	89739(27.22)	917	70806(21.48)	1202	94733(28.73)
Folic Acid Maternal Behavior										
Yes	58	6310(1.91)	159	14843(4.49)	356	28454(8.61)	394	29883(9.04)	826	63370(19.17)
No	146	14263(4.31)	448	39839(12.05)	764	61323(18.55)	526	40930(12.38)	375	31347(9.48)
Total	206	20882(6.22)	612	55071(16.54)	1120	99777(27.16)	925	70813(21.42)	1201	94717(28.65)
Breastfeeding Maternal Knowledge										
Yes	174	17999(5.56)	533	47343(14.63)	969	78826(24.37)	769	60437(18.68)	944	73733(22.79)
No	8	884(0.27)	55	5355(1.66)	127	9702(3.00)	130	9165(2.83)	246	20054(6.20)
Total	206	20882(5.83)	612	55698(16.29)	1096	88528(27.37)	899	69603(21.51)	1190	93788(28.99)
Breastfeeding Maternal Behavior										
Yes	153	16206(5.01)	328	30147(9.32)	685	54721(16.91)	675	52650(16.27)	1058	84126(26.00)
No	36	3579(1.11)	242	21510(6.65)	392	33761(10.43)	210	16844(5.21)	125	10000(3.09)
Total	206	20882(6.12)	612	51657(15.97)	1077	88483(27.34)	885	69494(21.48)	1183	94126(29.09)
Infant Sleep Position Maternal Knowledge										
Yes	149	15225(4.76)	512	46689(14.60)	927	75535(23.62)	761	59244(18.52)	939	74697(23.35)
No	20	1989(0.62)	67	5320(1.66)	159	12187(3.81)	135	9767(3.05)	251	19192(6.00)
Total	206	20882(5.38)	612	52609(16.26)	1086	87722(27.43)	896	69012(21.57)	1190	93889(29.35)
Infant Sleep Position Maternal Behavior										
Yes	102	10583(3.29)	330	32201(10.01)	649	52256(16.24)	552	43842(13.63)	869	68683(21.35)
No	85	8912(2.77)	233	19254(5.98)	419	35739(11.11)	331	25345(7.88)	301	24900(7.74)
Total	206	20882(6.06)	563	51455(15.99)	1068	87995(27.35)	883	69188(21.51)	1170	93583 (29.09)
Age[4]										
18-24	72	7486(2.25)	303	27894(8.38)	556	45349(13.63)	301	23016(6.92)	61	5116(1.54)
25-32	73	7256(2.18)	155	14443(4.34)	367	30196(9.07)	373	29587(8.89)	533	42306(12.71)

Table 8 (continued)

	≤ 8th Grade		9th-11th Grade		12th Grade		13th-15th Grade		≥ 16th Grade	
	N[1]	W[2](%)[3]	N	W(%)	N	W(%)	N	W(%)	N	W(%)
33-39	34	3375(1.01)	41	2926(0.88)	179	13523(4.06)	220	15927(4.79)	561	43665(13.12)
≥40	5	574(0.17)	8	374(0.11)	21	1186(0.36)	31	2590(0.78)	49	3866(1.16)
Total	184	18691(5.61)	507	45637(13.71)	1123	90254(27.12)	925	71120(21.38)	1204	94953(28.53)
Race										
Non Hispanic White										
	182	19084(5.73)	400	38966(11.71)	715	61578(18.50)	600	47187(14.18)	963	77537(23.30)
Non Hispanic Black										
	19	1302(0.39)	184	13036(3.92)	375	25830(7.76)	291	21111(6.34)	166	12366(3.72)
American Indian										
	1	156(0.05)	14	1530(0.46)	15	1308(0.39)	6	1308(0.16)	3	516(0.06)
Asian										
	0	0(0.00)	1	1203(0.05)	25	1969(0.59)	27	2153(0.65)	71	1736(1.43)
Total	202	(6.17)	599	(16.14)	1130	(27.24)	924	(21.33)	1203	(28.51)
Ethnicity										
Hispanic										
Yes	157	17037(5.12)	153	16636(5.00)	148	14136(4.25)	48	3693(1.11)	38	3158(0.95)
No	49	3846(1.16)	457	38214(11.49)	983	6705(23.06)	877	67427(20.27)	1166	91793(27.59)
Total	206	20882(6.28)	610	54860(16.49)	1131	90841(27.31)	925	71120(21.38)	1204	94951(28.54)
Income										
< $ 10,000										
	71	6816(2.24)	253	22027(7.25)	297	22506(7.41)	113	9287(3.06)	22	1005(0.33)
$10,000-24,999										
	69	6829(2.25)	186	11031(5.61)	391	30902(10.17)	255	18934(6.24)	67	6039(1.99)
$25,000-49,999										
	10	1054(0.35)	44	4001(1.32)	234	20299(6.68)	244	18365(6.04	217	18470(6.08)
≥ $50,000										
	2	174(0.06)	20	1672(0.55)	120	9817(3.23)	261	20373(6.71)	870	67346(22.17)
Total	152	14873(4.90)	503	38731(14.73)	1040	83524(27.49)	873	66959(22.05)	1176	92760(30.57)

Table 8 (continued)

	$\leq 8^{th}$ Grade		9^{th}-11^{th} Grade		12^{th} Grade		13^{th}-15^{th} Grade		$\geq 16^{th}$ Grade	
	N[1]	W[2](%)[3]	N	W(%)	N	W(%)	N	W(%)	N	W(%)
Married										
Yes	83	8330(2.50)	176	16790(5.04)	548	43132(12.96)	579	44303(13.31)	1108	85878(25.80)
No	123	12552(3.77)	436	38230(11.49)	583	47709(14.34)	346	26817(8.06)	96	9073(2.73)
Total	206	20882(6.27)	612	55020(16.53)	1131	90841(27.29)	725	71120(21.37)	1204	94951(28.53
Other Children										
Yes	131	12714(3.87)	329	30842(9.40)	625	52416(15.43)	493	40282(12.27)	573	49257(15.01)
No	62	6987(2.13)	264	22171(6.76)	498	37509(11.43)	421	30855(9.25)	628	45657(13.91)
Total	193	19701(6.00)	593	53013(16.16)	1123	89925(27.41)	914	70637(21.52)	1201	94907(28.92)
Single Birth										
Yes	200	20787(6.23)	589	5444(16.32)	1057	89064(26.76)	866	69936(21.01)	1105	93110(27.98)
No	6	95(0.03)	23	576(0.17)	74	1777(0.53)	59	1184(0.36)	99	1841(0.55)
Total	206	20882(6.28)	612	55020(16.53)	1131	90841(27.29)	925	71120(21.37)	1204	94951(28.53)
Non-Medicaid Insurance										
Yes	21	2398(0.72)	127	11701(3.53)	441	34076(10.27)	595	45361(13.67)	1079	85180(25.68)
No	184	18355(5.53)	481	43142(13.00)	684	56029(16.89)	328	25730(7.76)	124	9758(2.94)
Total	205	20752(6.25)	608	54843(16.53)	1125	90106(27.16)	923	71091(21.43)	1203	94938(28.62)
Medicaid										
Yes	28	2650(0.80)	194	15826(4.77)	207	16427(4.95)	89	6246(1.88)	23	1887(0.57)
No	177	18103(5.46)	414	38899(11.73)	918	73778(22.24)	835	64874(19.56)	1178	93029(28.04)
Total	205	20752(6.26)	608	54724(16.50)	1125	90206(27.19)	924	71107(21.44)	1201	94916(28.61)
Planned Pregnancy										
Yes	112	10935(3.32)	250	23188(7.05)	549	44561(13.61)	473	36762(11.17)	949	73730(22.41)
No	89	9718(2.95)	354	31023(9.43)	566	44782(13.55)	442	33810(10.28)	244	20467(6.22)
Total	201	20652(6.27)	604	54212(16.48)	1115	89343(27.16)	915	70572(21.45)	1193	94196(28.63)
Stress										
Yes	49	4590(1.39)	152	12452(3.78)	304	20706(6.29)	255	18779(5.70)	256	18134(5.50)
No	156	16166(4.91)	446	40894(12.42)	816	69482(21.10)	662	51858(15.75)	942	76264(23.16)
Total	205	20756(6.30)	598	53346(16.20)	1120	90189(27.39)	917	70637(21.45)	1198	94399(28.66)

Table 8 (continued)

	≤ 8th Grade		**9th-11th Grade**		**12th Grade**		**13th-15th Grade**		**≥ 16th Grade**	
	N[1]	W[2](%)[3]	N	W(%)	N	W(%)	N	W(%)	N	W(%)
Depression										
Yes	89	9020(2.74)	287	24656(7.50)	504	38692(11.76)	380	27920(8.49)	368	27485(8.35)
No	111	11130(3.39)	311	29185(8.87)	611	51282(15.59)	532	42550(12.94)	832	66994(20.37)
Total	200	20150(6.13)	598	53841(16.37)	1115	89974(27.35)	912	70470(21.43)	1200	94480(28.72)
Intensive Care Unit (ICU)										
Yes	42	1657(0.50)	153	5671(1.72)	318	10230(3.11)	250	6197(1.89)	270	7842(2.39)
No	160	1877(5.71)	439	47356(14.42)	799	79984(24.35)	663	64061(19.50)	929	86720(26.40)
Total	202	20428(6.21)	592	53027(16.14)	1117	90214(27.46)	913	70259(21.39)	1199	94562(28.79)

Note: [1]N = refers to the unweighted sample size.
[2]W=weighted totals.
[3]Percentages may not equal 100% due to rounding.
[4]Teenagers=n=135 w=4090 (3.30%).

Table 9: Total Number with Means of all Variables for Two Different Time Periods of the NC PRAMS Data

	Phase 3 1997-1998-1999		**Phase 5 2005-2007-2008**		**Total Phase 3 & Phase 5**	
	Number	Mean (%)	Number	Mean (%)	Number	Mean (%)
Folic Acid Maternal Knowledge						
	4383	73	4036	84	8419	79
Folic Acid Maternal Behavior						
	4400	46	4052	44	8452	45
Breastfeeding Maternal Knowledge						
	4311	88	3955	86	8266	87
Breastfeeding Maternal Behavior						
	2762	44	3904	74	6666	62
Infant Sleep Position Maternal Knowledge						
	4261	84	3920	84	8181	84
Infant Sleep Position Maternal Behavior						
	3876	46	3871	65	7747	55
Maternal Education in Years						
	4425		5936		8503	
$\leq 8^{th}$		04		05		05
9^{th} -11^{th}		17		15		16
12^{th}		34		28		31
13^{th}-15^{th}		23		23		22
$\geq 16^{th}$		22		29		25
Maternal Age in Years						
	4425		4078		8503	
<18		06		03		05
18-24		36		36		34
25-32		35		35		36
33-39		21		23		23
≥40		02		02		02
Race	4425		4078		8503	
Nonhispanic White		67		70		68
Nonhispanic Black		30		25		28
Nonhispanic Asian		01		03		02
American Indian		02		01		01
Ethnicity	4425		4075		9703	
Hispanic		05		13		09
Income	4425		4078		8503	
<$10,000		20		20		20
$10,000-$24,999		30		26		28
$25,000-$49,999		26		20		23
≥$50,000		24		34		29
Married	4425	65	5936	61	8503	63

Table 9 (continued)

	Phase 3 1997-1998-1999		**Phase 5 2005-2007-2008**		**Total Phase 3 & Phase 5**	
	Number	Mean (%)	Number	Mean (%)	Number	Mean (%)
Parity (Previous Live Births)						
	4381	51	4024	54	8405	52
Single Birth	4425	93	5936	94	8503	94
Insurance	4409	61	4064	50	8473	59
Medicaid	4419	13	4063	13	8482	13
Planned Pregnancy	4130	55	4028	58	8158	57
Prenatal Stress	4330	28	4038	25	8368	27
Postnatal Depression	4374	26	4025	40	8399	33
Infant in Intensive Care (ICU)						
	4341	32	4023	26	8364	29

Table 10: Logistic Regression Stating Unadjusted and Adjusted Odds (Model 1) and P-Value of the Association Between Educational Attainment Level and Folic Acid, Breastfeeding, and Infant Sleep Position Knowledge and Behavior for the Two Time Periods (i.e., Phase 3 & Phase 5)

	Phase 3 1996-1997-1998					Phase 5 2005-2007-2008				
	Unadjusted		Adjusted[1] Model 1			Unadjusted		Adjusted Model 1		
Grades	**OR**	**P-value**	**OR**	**95%CI**	**P-value**	**OR**	**P-value**	**OR**	**95%CI**	**P-value**
Folic Acid Consumption Knowledge										
	(*n*=4383)		**(*n*=3891)**			**(*n*=4036)**		**(*n*=3865)**		
$\leq 8^{th}$	0.52	<.0001	0.57	0.33-0.98	0.04	1.17	0.50	0.88	0.50-1.53	0.64
$9\text{-}11^{th}$	0.53	<.0001	0.68	0.50-0.92	0.01	0.73	0.03	0.88	0.64-1.21	0.42
12^{th}	Referent		Referent			Referent		Referent		
$13^{th}\text{-}15^{th}$	1.99	<.0001	1.70	1.26-2.28	<.0001	1.66	<.0001	1.56	1.11-2.17	0.01
$\geq 16^{th}$	6.10	<.0001	4.00	2.47-6.50	<.0001	6.01	<.0001	3.18	2.05-4.98	<.0001
Folic Acid Consumption Behavior										
	(*n*=4400)		**(*n*=3908)**			**(*n*=4052)**		**(*n*=3869)**		
$\leq 8^{th}$	1.08	0.72	1.07	0.60-1.90	0.81	0.95	0.81	0.95	0.58-1.55	0.83
$9\text{-}11^{th}$	0.77	0.05	0.84	0.61-1.16	0.20	0.80	0.11	0.89	0.65-1.22	0.46
12^{th}	Referent		Referent			Referent		Referent		
$13^{th}\text{-}15^{th}$	1.96	<.0001	1.38	1.08-1.77	0.01	1.57	<.0001	1.30	1.01-1.67	0.04
$\geq 16^{th}$	4.14	<.0001	1.82	1.36-2.43	<.0001	4.36	<.0001	2.25	1.73-2.93	<.0001
Breastfeeding Knowledge										
	(*n*=4311)		**(*n*=3844)**			**(*n*=3955)**		**(*n*=3790)**		
$\leq 8^{th}$	1.49	0.30	1.20	0.47-3.08	0.71	2.50	0.03	2.26	0.92-5.53	0.07
$9\text{-}11^{th}$	1.28	0.28	1.04	0.59-1.83	0.88	1.09	0.69	1.00	0.64-1.56	1.00
12^{th}	Referent		Referent			Referent		Referent		
$13^{th}\text{-}15^{th}$	0.85	0.35	0.01	0.68-1.51	0.95	0.81	0.22	0.88	0.62-1.25	0.47
$\geq 16^{th}$	0.58	<.0001	0.88	0.57-1.35	0.56	0.45	<.0001	0.62	0.44-0.87	0.01
Breastfeeding Behavior										
	(*n*=2762)		**(*n*=2466)**			**(*n*=3904)**		**(*n*=3757)**		

Table 10 (continued)

	Phase 3 1996-1997-1998					Phase 5 2005-2007-2008				
	Unadjusted		**Adjusted[1] Model 1**			**Unadjusted**		**Adjusted Model 1**		
Grades	**OR**	**P-value**	**OR**	**95%CI**	**P-value**	**OR**	**P-value**	**OR**	**95%CI**	**P-value**
$\leq 8^{th}$	1.84	0.01	0.63	0.31-1.28	0.20	2.79	<.0001	1.08	0.62-1.88	0.79
$9\text{-}11^{th}$	0.58	<.0001	0.64	0.47-0.99	0.04	0.87	0.27	0.87	0.64-1.17	0.34
12^{th}	Referent		Referent			Referent		Referent		
13^{th} -15^{th}	2.92	<.0001	2.65	1.94-3.63	<.0001	1.93	<.0001	2.00	1.54-2.61	<.0001
$\geq 16^{th}$	7.59	<.0001	4.49	3.07-6.57	<.0001	5.19	<.0001	3.86	2.80-5.32	<.0001
Infant Sleep Position Knowledge										
	(*n*=4261)		**(*n*=3808)**			**(*n*=3920)**		**(*n*=3774)**		
$\leq 8^{th}$	1.35	0.38	0.92	0.40-2.08	0.83	1.24	0.48	1.76	0.88-3.53	0.11
$9\text{-}11^{th}$	1.29	0.21	1.00	0.64-1.56	0.99	1.42	0.08	1.50	0.98-2.31	0.06
12^{th}	Referent		Referent			Referent		Referent		
13^{th} -15^{th}	0.92	0.61	1.02	0.73-1.44	0.93	0.98	0.89	1.07	0.61-1.49	0.69
$\geq 16^{th}$	0.78	0.10	1.19	0.80-1.77	0.40	0.63	<.0001	0.85	0.49-1.18	0.33
Infant Sleep Position Behavior										
	(*n*=3876)		**(*n*=3476)**			**(*n*=3871)**		**(*n*=3725)**		
$\leq 8^{th}$	0.68	0.08	0.63	0.36-1.11	0.11	0.81	0.27	0.54	0.34-0.85	0.01
$9\text{-}11^{th}$	0.76	0.04	0.71	0.52-0.96	0.03	1.14	0.31	1.16	0.87-1.56	0.32
12^{th}	Referent		Referent			Referent		Referent		
13^{th} -15^{th}	0.98	0.0001	0.96	0.75-1.22	0.71	1.18	0.14	1.13	0.88-1.45	0.34
$\geq 16^{th}$	1.52	0.0001	1.23	0.93-1.63	0.15	1.89	<.0001	1.35	1.03-1.77	0.03

Note: [1]Adusted for: age, race, ethnicity, income, non-Medicaid insurance, Medicaid, married, parity, single birth, infant in ICU, planned pregnancy, prenatal stress, and postpartum depression

Table 11: Model 2: Logistic Regression Stating Unadjusted and Adjusted Odds and P-value of the Association Between Educational Attainment Levels and Folic Acid, Breastfeeding, and Infant Sleep Position Knowledge and Behavior for the Two Time Periods (i.e., Phase 3 & Phase 5)

	Phase 3 1996-1997-1998 Adjusted[1] Model 2			**Phase 5 2005-2007-2008 Adjusted Model 2**		
Grades	**OR**	**95%CI**	**P-value**	**OR**	**95%CI**	**P-value**
Folic Acid Consumption Knowledge						
	(*n*=4365)			**(*n*=4018)**		
≤8th	0.64	0.40-1.02	0.06	0.83	0.48-1.41	0.48
9-11th	0.64	0.48-0.84	<.0001	0.80	0.58-1.09	0.16
12th	Referent			Referent		
13th -15th	1.68	1.27-1.21	<.0001	1.53	1.11-1.09	0.01
≥ 16th	3.52	2.25-5.52	<.0001	3.62	2.34-5.62	<.0001
Folic Acid Consumption Behavior						
	(*n*=4382)			**(*n*=4039)**		
≤8th	1.14	0.70-1.86	0.60	0.94	0.60-1.48	0.79
9-11th	0.89	0.67-1.19	0.45	0.84	0.63-1.13	0.26
12th	Referent			Referent		
13th -15th	1.54	1.23-1.94	<.0001	1.28	1.00-1.63	0.04
≥ 16th	1.00	1.52-2.62	<.0001	2.55	1.98-3.27	<.0001
Breastfeeding Knowledge						
	(*n*=4294)			**(*n*=3938)**		
≤8th	2.49	0.35-1.19	0.78	2.41	0.99-5.85	0.05
9-11th	1.83	0.40-2.15	0.67	1.01	0.66-1.44	0.97
12th	Referent			Referent		
13th -15th	1.42	2.15-3.83	0.92	0.88	0.63-1.24	0.48
≥ 16th	1.36	3.59-7.36	0.66	0.62	0.44-0.87	0.01
Breastfeeding Behavior						
	(*n*=2749)			**(*n*=3884)**		
≤8th	0.64	0.34-1.16	0.16	1.00	0.59-1.08	1.00
9-11th	0.59	0.38-0.83	<.0001	0.81	0.60-1.08	0.15
12th	Referent			Referent		
13th -15th	2.87	2.21-3.93	<.0001	2.03	1.56-2.62	<.0001
≥ 16th	5.14	3.68-7.49	<.0001	3.24	3.24-6.00	<.0001
Infant Sleep Position Knowledge						
	(*n*=4244)			**(*n*=3902)**		
≤8th	1.11	0.53-2.31	0.78	1.41	0.75-2.63	0.28
9-11th	1.09	0.72-1.65	0.69	1.38	0.93-2.06	0.12
12th	Referent			Referent		
13th -15th	1.18	0.86-1.63	0.31	1.07	0.78-1.50	0.65
≥ 16th	1.42	0.99-2.06	0.06	0.84	0.61-1.16	0.29
Infant Sleep Position Behavior						
	(*n*=3859)			**(*n*=3854)**		

Table 11 (continued)

	Phase 3 1996-1997-1998 Adjusted[1] Model 2			Phase 5 2005-2007-2008 Adjusted Model 2		
Grades	**OR**	**95%CI**	**P-value**	**OR**	**95%CI**	**P-value**
≤8th	0.56	0.34-0.93	0.03	0.56	0.36-0.86	<.0001
9-11th	0.76	0.58-1.00	0.05	0.14	0.86-1.51	0.37
12th	Referent			Referent		
13th -15th	0.96	0.77-1.21	0.76	1.12	0.88-1.44	0.35
≥ 16th	1.24	0.95-1.62	0.11	1.39	1.07-1.87	0.01

Note: [1]Model 2 includes the variables: age, race, ethnicity, income, educational attainment, Non-Medicaid insurance, and Medicaid.

Table 12: Logistic Regression Stating Unadjusted OR, Adjusted OR, 95% CI, & P-Values of the Knowledge and Behavior of Folic Acid, Breastfeeding, and Infant Sleep Position between the Two Time Periods [Phase 3 (1997-1998-1999) & Phase 5 (2005-2007-2008)], Stratified by Educational Attainment Level, Using Phase 3 as the Referent Group

	Unadjusted			Model 1[1]			Model 2[2]		
Grades	**OR**	**95%CI**	**p-value**	**OR**	**95%CI**	**p-value**	**OR**	**95%CI**	**p-value**
Folic Acid Knowledge									
≤8th (*n*=393)	2.24	1.84-5.79	<.0001	5.76	2.59-12.76	<.0001	4.01	2.08-7.71	<.0001
9-11th (*n*=1356)	1.96	1.45-2.65	<.0001	1.65	0.98-2.50	<.0001	1.74	1.24-2.45	<.0001
12th (*n*=2589)	1.43	1.13-1.81	<.0001	1.32	0.98-1.78	0.06	1.40	1.06-1.84	0.02
13-15th(*n*=1920)	1.20	0.87-1.64	0.27	1.43	0.91-2.25	0.13	1.51	0.98-2.32	0.06
≥ 16th (*n*=2161)	1.41	0.89-2.49	0.15	0.44	0.15-1.26	0.13	1.12	0.37-3.91	0.75
Folic Acid Behavior									
≤8th (*n*=399)	0.71	0.42-1.21	0.21	0.84	0.41-1.74	0.64	0.62	0.34-1.13	0.12
9-11th (*n*=1369)	0.84	0.61-1.15	0.27	0.84	0.58-1.23	0.37	0.75	0.53-1.05	0.09
12th (*n*=2597)	0.81	0.65-1.00	0.05	0.85	0.65-1.12	0.25	0.93	0.72-1.19	0.55
13-15th(*n*=1931)	0.65	0.52-0.81	<.0001	0.67	0.48-0.94	0.02	0.70	0.51-0.94	0.02
≥ 16th (*n*=2156)	0.85	0.68-1.06	0.15	0.93	0.48-1.83	0.84	1.22	0.68-2.20	0.51
Breastfeeding Knowledge									
≤8th (*n*=365)	1.43	0.49-4.16	0.51	1.39	0.31-6.30	0.67	1.78	0.48-6.66	0.39
9-11th (*n*=1321)	0.72	0.44-1.20	0.21	0.71	0.39-1.29	0.26	0.84	0.50-1.40	0.50
12th (*n*=2543)	0.82	0.61-1.19	0.34	0.67	0.45-0.99	0.04	0.70	0.49-0.99	0.05
13-15th(*n*=1888)	0.81	0.58-1.14	0.23	0.52	0.31-0.89	0.02	0.59	0.36-0.95	0.03
≥ 16th (*n*=2149)	0.70	0.51-0.87	<.0001	0.57	0.31-1.04	0.06	0.52	0.29-0.92	0.02
Breastfeeding Behavior									
≤8th (*n*=319)	5.14	2.75-9.61	<.0001	4.91	1.69-14.33	<.0001	3.75	1.67-8.40	<.0001
9-11th (*n*=1080)	5.06	3.54-7.21	<.0001	4.46	2.91-6.84	<.0001	4.18	2.81-6.20	<.0001
12th (*n*=2003)	3.38	2.67-4.28	<.0001	3.65	2.71-4.92	<.0001	3.52	2.68-4.64	<.0001
13-15th(*n*=1477)	2.23	1.70-2.93	<.0001	2.71	1.81-4.05	<.0001	2.57	1.76-3.74	<.0001
≥ 16th (*n*=1787)	2.31	1.68-3.17	<.0001	2.76	1.16-6.56	0.02	2.84	1.25-6.47	<.0001
Infant Sleep Position Knowledge									

Table 12 (continued)

Grades	OR	Unadjusted 95%CI	p-value	OR	Model 1[1] 95%CI	p-value	OR	Model 2[2] 95%CI	p-value
≤8th (*n*=384)	0.81	0.35-1.88	0.62	2.21	0.52-9.34	0.28	0.89	0.35-2.25	0.80
9-11th (*n*=1306)	0.97	0.61-1.56	0.91	1.20	0.67-2.14	0.54	1.10	0.66-1.84	0.70
12th (*n*=2509)	0.88	0.66-1.19	0.42	0.73	0.50-1.07	0.10	0.81	0.57-1.13	0.21
13-15th (*n*=1882)	0.94	0.68-1.29	0.69	0.85	0.53-1.38	0.52	0.83	0.53-1.30	0.41
≥ 16th (*n*=2136)	0.71	0.54-0.94	0.01	0.63	0.24-1.66	0.35	0.57	0.23-1.42	0.22
Infant Sleep Position Behavior									
≤8th (*n*=347)	1.98	1.16-3.38	0.02	1.58	0.72-3.48	0.25	1.78	0.94-3.36	0.08
9-11th (*n*=1208)	2.48	1.83-3.45	<.0001	2.21	1.55-3.14	<.0001	2.01	1.48-2.77	<.0001
12th (*n*=2357)	1.66	1.34-2.03	<.0001	1.59	1.23-2.05	<.0001	1.60	1.26-2.0	<.0001
13-15th (*n*=1783)	1.99	1.58-2.52	<.0001	2.11	1.51-2.96	<.0001	2.07	1.51-2.85	<.0001
≥ 16th (*n*=2052)	2.05	1.64-2.56	<.0001	1.53	0.81-2.90	0.20	1.58	0.86-2.90	0.14

Note: [1]Model 1 includes the variables: age, race, ethnicity, income, non-Medicaid insurance, Medicaid, having other children, married, single birth, planned pregnancy, stress, depression, and ICE usage in the adjusted model.
[2]Model 2 includes the variables: age, race, ethnicity, income, non-Medicaid insurance and Medicaid.

Literacy ⇒ **(Educational Attainment)**	Health Contexts **(SES, lifestyle, psychological, & birth factors)** ⇓ HEALTH LITERACY **(The knowledge people acquire during the years of formal education and through life experiences that enable them to initiate proper care for their infants.)** ⇑ Individuals **(Women who have had a live birth and answered the mailed PRAMS survey.)**	Health Outcomes & Cost ⇒ **(The knowledge and behavior of: Folic Acid Consumption Infant Breastfeeding Infant Sleep Position)**

Figure 1: Institute of Medicine (2004) Health Literacy Framework with Study Variables Embedded in Model

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