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The Effect of Dietary Interventions on Fetal Birth Weights in Pregnant Adolescents: A Systematic Review

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THE EFFECT OF DIETARY INTERVENTIONS ON FETAL BIRTH WEIGHTS IN PREGNANT ADOLESCENTS: A SYSTEMATIC REVIEW

by

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ABSTRACT

Nutrition status during adolescent pregnancy and childbearing is a complex, multifaceted condition that can impact the health status of the teen mother and her baby. Adolescent mothers are at higher risk for low birth weight infants because of the unique dietary requirements needed to accommodate for both the growth needs of the adolescent mother and her unborn child.

The purpose of this research was to examine dietary interventions that have the greatest effect on fetal birth weight outcomes in adolescent mothers. Secondly, this study explored dietary nutrients effective in reducing the likelihood of complications commonly associated with low birth weight infants in adolescent pregnancy.

A systematic literature review was conducted from the following online databases: Cumulative Index to Nursing and Allied Health Literature (CINAHL), Medical Literature On-line (MEDLINE), Education Resources Information Center (ERIC), and PsycInfo. Initial search terms included 'adolescent', 'nutrition', 'diet', and 'prenatal'. Further search items included 'weight' and 'outcome'. Selected articles included those published between 2000-2013, written in English, and peer-reviewed.

Significant evidence supported positive birth weight outcomes for dietary supplementation with zinc and calcium, and BMI-specific weight gains for adolescent pregnancy. No significant evidence was provided on the effect of iron and fatty acid composition on birth weight outcomes. Results for other dietary interventions and their effects on fetal birth weight were either inconclusive or absent.

Discovering dietary interventions that work best in prenatal care of adolescent populations will allow for more individually-tailored, dietary specific interventions to be developed to combat the prevalence of low fetal birth weight infants in adolescent pregnancy.

Keywords: Adolescent, Pregnancy, Birth weight, Diet, Nutrition, Intervention

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INTRODUCTION

In the United States (US), adolescent pregnancies comprise 10% of total births every year (Magness, 2012). While the overall number of adolescent pregnancies has steadily decreased in the last two decades, the US continues to have higher rates of adolescent pregnancy when compared to other industrialized nations (Magness, 2012). Pregnancy during adolescence can be problematic due to higher risk for maternal adiposity, obesity, anemia, and diabetes; all of which correlate with low fetal birth weight outcomes (Wise & Arcamone, 2011). The negative consequences of adolescent pregnancy often place both the adolescent and the unborn child at risk for the development of chronic health conditions during adulthood, leading to a shorter lifespan and an increased use of healthcare resources. As a result, the health-related implications of adolescent pregnancies have been recognized as a national concern and have been scored as a topic of prevention in the Healthy People 2020 objectives (Magness, 2012).

Adolescent pregnancies are often labeled as high risk pregnancies because of the lack of healthful dietary intake associated with the adolescent mother (Stang, 2005). In general, dietary deficiencies of macro-and micro-nutrients are commonly found in female adolescent populations in most industrialized nations (Derbyshire, 2007). Female adolescents are more likely to consume fewer nutrient dense calories and have smaller intakes of folic acid, calcium, and iron (Derbyshire, 2007). Deficiencies in key nutrient intake before and during the course of pregnancy are often the cause of poor birth outcomes, including low-birth weight infants, in pregnant adolescents.

Pregnancy is often regarded as an optimal time for learning in most maternal populations (Montgomery, 2003). Although pregnant adolescents are certainly no different, they often encounter additional stressors (ex: lack of education, limited means of transportation, and nonjudgmental emotional support) that are unique to their age group. Age related stressors can affect the pregnant adolescent's focus on positive health-related behaviors and eliminate their drive to adopt healthy life-style changes (Chen et al., 2005).

PROBLEM

Adolescent mothers are at risk for low birth weight (LBW) infants because of the additional dietary demands necessary to support the growth and development requirements of both the adolescent mother and her unborn child (Kristen S. Montgomery, 2003). Although adolescent mothers have a strong interest in dietary education and exhibit an increased aptitude for readiness to learn about changes in the body associated with all aspects of pregnancy, there are unique stressors that may impair the pregnant adolescent's ability to learn (Wise & Arcamone, 2011; Chen et al., 2005).

To address the outcomes related to low fetal birth rates in adolescent pregnancies, age-appropriate and effectual dietary interventions for the pregnant adolescent must be identified. Determining which dietary interventions optimize nutritional intake for pregnant adolescents will give way to more efficient prenatal programs that cater specifically to adolescent mothers. Dietary interventions aimed at reducing the risk of low-birth weight infants born to adolescent mothers can change the incidence of high risk pregnancies and poor fetal outcomes in this population.

PURPOSE

The primary aim of this literature review is to analyze evidence on the use of dietary interventions and strategies in pregnant adolescents to optimize nutrient intake and to determine their effect on fetal birth weight outcomes. A secondary analysis will compare and evaluate the effectiveness of dietary interventions that show improved fetal birth weight outcomes in the pregnant adolescent woman. Implications for future research aimed at reducing the risk of low-birth weight infants born to adolescent mothers will be discussed.

Results of this study will provide insight and motivation to program developers for future and current adolescent prenatal programs. The information collected will allow providers to appropriately address the diet and nutritional issues unique to high-risk, populations in pregnancy. Furthermore, this review will be able to shed new light on how nurses can effectively tailor their care and interventions for at-risk adolescent populations during pregnancy.

METHODS

Literature considered and reviewed was collected through the following databases: Cumulative Index to Nursing and Allied Health Literature (CINAHL), Medical Literature On-line (MEDLINE), Education Resources Information Center (ERIC), and PsycInfo. An online search was completed to investigate the effects of dietary interventions on the adolescent mother. Initial search terms will include "adolesc*", "nutrition*" or "diet*", and "pregnan*" or "prenatal". Further search items included "*weight", "outcome*", and "teen*". Articles were specified to include publications from 2000-2013, written in the English language, and from peer-reviewed journals. Content-related limiters include only those articles that focus on pregnant adolescents and birth weight outcomes of the pregnant adolescent. The search was specified to include adolescent mothers specifically in the 12 to 18 year old age range.

Information was organized using three separate tables. Table 1 organized the study structure, results, limitations, and nursing relevance. Table 2 organized the general topics covered in each study. Table 3 outlined the specific effects on birth outcomes in the pregnant adolescent. Tables allowed for adjacent comparison between findings. Additional data from current articles, journals, and studies found outside of the electronic database and relevant to adolescent pregnancy and birth weight outcomes were also included in the discussion.

BACKGROUND

Pregnancy is a period of immense growth and change for many women. The prenatal time can invoke many changes in a woman's physiologic, emotional, and social environments. These new and crucial changes have sparked research across the globe on improving birth outcomes specifically in high risk populations. Both the UN's Millennium Development Goals (Bahl et al., 2012)and the Healthy People 2020 (Magness, 2012) objectives have marked neonatal mortality and morbidity as crucial to improving the health of our communities, our nations, and the world.

Adolescence and pregnancy characterize very critical physiological phases of the human life cycle (Derbyshire, 2007). New periods of growth cause an increased level of stress on the body, and a shift in nutrient demands (Derbyshire, 2007). Specifically in adolescence, managing the experience of physiological changes, as well as emotional and psychological fluctuations, is often challenging (Montgomery, 2003).

Adolescent pregnancy is a merging of two very active life cycle phases; causing adolescent pregnancy to become a topic of intense discussion amongst many public health organizations across the globe. Researchers question if adolescent individuals, still in a phase of critical growth and development themselves, are able to effectively carry a fetus to term with positive birth outcomes (Goonewardene & Waduge, 2005). The lack of research on diet and nutrient demands in this population has forced quality of caloric intake during adolescent pregnancy into the spotlight as an important part of focused health care initiatives. Key areas of research focused on dietary interventions to optimize nutritional status, improve pregnancy outcomes, and boost maternal health for adolescent mothers have been identified as targets for public health indicators.

Prenatal Care and Nutritional Status

Broad goals of prenatal care include health promotion of all individuals involved with the mother (family and newborn included). The goals associated with prenatal care begin before pregnancy and continue through the newborn’s development into childhood (Noonan, Corman, Schwartz-Soicher, & Reichman, 2013). The number and quality of maternal healthcare encounters during the prenatal period can affect the newborn’s health trajectory (Noonan et al., 2013). A key facet of health promotion during the prenatal period is nutrition and weight management ("Chapter 10: promoting a healthy pregnancy," 2009). The expectant mother must be educated on many new dietary practices to meet the needs of pregnancy such as caloric intake, protein, essential vitamins and minerals. All dietary practices to support fetal growth and development, as well as the adolescent mother’s, need to be addressed to promote a healthy environment and optimize survival outcomes ("Chapter 10: promoting a healthy pregnancy," 2009).

Although prenatal care is a high priority, it is often not delivered in a timely manner, particularly in adolescent women (Noonan et al., 2013). In 2006, the percentage of mothers that began prenatal care during their first trimester actually declined from previous years (Mathews, 2009). In 2012, most American women reported less than 5 prenatal visits during their entire pregnancy (Hamilton, Martin, & Ventura, 2013). The United States Department of Health and Human Services recommends that mothers visit their health care providers for prenatal visits at least eight times during the prenatal period, because the key to healthy outcomes in mothers and babies is early and timely prenatal care (Debiec, Paul, Mitchell, & Hitti, 2010). Mothers who do not engage in quality prenatal care are three times more likely to have lower birth weight babies, and five times more like to die during birth (Noonan et al., 2013).

Multiple studies have found that the diet of most non-pregnant adolescents is not sufficient for the pre-conception environment. Adolescents are more likely than adults to consume meals that are poor in most micronutrients (Baker et al., 2009). This can put them at risk for a variety of birth complications and impaired fetal and maternal health outcomes. Mothers who are prenatally malnourished are more likely to give birth to babies who have increased risks of fetal demise, lung disease, poor growth, and poor developmental outcomes (Derbyshire, 2007).

The risks for fetal anomalies, including LBW, in adolescent pregnancy begins before the child is delivered. One comparison study of non-pregnant and pregnant adolescents found that while adolescent mothers have the tendency to consume more micronutrients than their non-pregnant counterparts, their intake was still considered to be below the standard pre-natal requirements (Derbyshire, 2009). Non-pregnant adolescents living in industrialized countries are more likely to eat poor diets lacking the critical components of folate, vitamin D, and iron (Baker et al., 2009). Lacking the critical elements and micronutrients then not only puts the mother at risk, but the fetus at risk as well. In one study, Small for Gestational Age (SGA) babies were specifically associated with low folate and iron intake in pregnant adolescents (Baker et al., 2009). Results have associated that extremely poor nutrition can lead to poor birth outcomes and LBW which can lead to death of the infant (Montgomery, 2003).

Adolescent beliefs about good health and nutrition are often influenced by factors outside the home food environment. Psychosocial beliefs about nutrition are frequently met with peer pressure, and can influence an adolescent mother’s dietary habits (Montgomery, 2003).

Etiology of High Risk Pregnancy in Adolescents

High risk pregnancies are categorized as pregnancies that negatively alter the health of a mother or her unborn child. These pregnancies include but are not limited to: pregnancies with comorbid diseases (i.e.: diabetes, hypertension, etc.), mothers of advanced maternal age, young mothers, multiple births, and overweight/obese mothers (Society for Maternal-Fetal Medicine, n.d.).

Adolescent Pregnancy

Adolescent pregnancies are often labeled as high risk pregnancies because of the lack of healthful dietary intake associated with the adolescent mother (Stang, 2005). In general, dietary deficiencies of macro-and micro-nutrients are commonly found in female adolescent populations in most industrialized nations (Derbyshire, 2007). Female adolescents are more likely to consume fewer nutrient dense calories and have smaller intakes of folic acid, calcium, and iron (Derbyshire, 2007). Deficiencies in key nutrient intake before and during the course of pregnancy are often the cause of poor birth outcomes, including low-birth weight infants, in pregnant adolescents.

While nutrition appears to be a crucial factor in preventing maternal and fetal morbidity and mortality in teenage pregnancy (Nielsen, Gittelsohn, Anliker, & O'Brien, 2006), it is not the only reason for high risk pregnancy outcomes in this population. In addition to nutrition, pregnant adolescents are often considered higher risk pregnancies due to the biological immaturity of the teen mother (Goonewardene & Waduge, 2005). This immaturity often leads to maternal comorbidities including: maternal anemia, pregnancy induced hypertension, spontaneous miscarriage, LBW infants, and prematurity (Goonewardene & Waduge, 2005). In fact, results from one 2010 study suggest that there are key differences between the in-utero environment of the adolescent mother versus the adult mother, which can affect birth weight outcomes (Ryan et al., 2011).

Additionally, many adolescent births result from unplanned pregnancies of teenagers in poverty, lower socioeconomic states and low education levels (Goonewardene & Waduge, 2005). Often times, pregnant adolescents lack the sufficient resources and knowledge to properly care for themselves and their unborn child during pregnancy. This has the potential to result in some dire birth outcomes, such as: LBW, pregnancy complications, and deficient nutrition in-utero. These outcomes have the potential to affect the child into their adult life. Any of these scenarios put the child at a higher risk of developing poor behavioral, cognitive, and physical problems (Goonewardene & Waduge, 2005).

Low Birth Weight (LBW) Pregnancy

Low birth weight (LBW) pregnancies are often considered a result of high risk pregnancies. Maternal nutrition from conception through the prenatal period determines the fetus's growth and development in the womb (Williamson, 2006). Babies less than 2,500 g are designated as LBW, and are often associated with increased morbidity and mortality, as well as increased risk for chronic diseases as an adult (Williamson, 2006). Improving birth outcomes and predicting fetal birth weights before delivery have become priorities for the National Institute of Health's 2009 National Standard for Normal Fetal Growth Projective (Society for Maternal-Fetal Medicine, n.d.).

Interventions for Adolescent Mothers

Teen pregnancy ranks as one of obstetrics' high risk categories and many interventions have been developed to address the cares and concerns that arise with adolescent pregnancy. In fact, one study on LBW outcomes suggests that adolescents should be considered a separate sub-group population (Ryan et al., 2011). New interventions to supplement the prenatal care process must be added to address adolescent mothers' special needs because they are at higher risk for LBW babies than adult mothers. The goals of most adolescent prenatal programs are to address the additional topics of: contraceptives after delivery, reducing subsequent pregnancies, child care, and financial instability and resources as needed (Bensussen-Walls & Saewyc, 2001).

A study on the effect of prenatal care in adolescents found that mothers more likely to receive no prenatal care during their pregnancy were often described as nulliparous, unmarried, on insurance they received from a third-party, smokers, and had a history of pre-term births. In this same analysis, women who did not receive any prenatal care experienced higher rates of premature birth. Similar results were yielded from mothers who attended less than 75% of expected prenatal visits. (Debiec, Paul, Mitchell, & Hitti, 2010)

The prenatal period is an important period of learning for the pregnant adolescent. It is an opportune time to teach adolescents good dietary habits and give them the proper resources to ensure they are successful in their pregnancy. (Montgomery, 2003) In addition, improvements in nutrition and dietary habits during pregnancy has the potential to develop into positive eating habits later on in the adolescent's life (Montgomery, 2003).

RESULTS

Many studies were considered for this review, but only five were selected as per the inclusion criteria. Four of the studies focused solely on adolescent outcomes (Castillo-Duran, Marin, Alcazar, Iturralde, & Ruz, 2001; Chan, McElligott, McNaught, & Gill, 2006; Nielsen, O'Brien, et al., 2006; Wheeler, Poston, Thomas, Seed, & Baker, 2011), but one study compared the outcomes of adolescent mothers to adult mothers (Meier, Nickerson, Olson, Berg, & Meyer, 2003).Of these studies, only two provided significant data on positive birth weight outcomes (Castillo-Duran et. al, 2001; Chan et. al., 2006). The other three studies stated that the interventions had no effect observed on birth weight outcomes (Meier et al., 2003; Nielsen, O'Brien, et al., 2006; Wheeler et al., 2011). All studies also provided other significant positive and negative outcomes that occurred. Of the studies analyzed, three were randomized control trials (Castillo-Duran et al., 2001; Chan et al., 2006; Meier et al., 2003). The remainder of the studies consisted of retrospective chart reviews (Nielsen, O'Brien, et al., 2006) and prospective interviews (Wheeler et al., 2011). All study structures, limitations, strengths/weaknesses, and outcomes were organized in Table 1. Relevant and general outcomes were further outlined in Table 2. Outcomes specifically related to the newborn were further organized into Table 3.

Two of the studies had strict participant enrollment policies in terms of gestational age (Castillo-Duran et al., 2001; Wheeler et al., 2011). The remainder of studies simply required involvement of the mother in study interventions and voluntary release of birth outcomes, most importantly birth weight (Chan et al., 2006; Meier et al., 2003; Nielsen, O'Brien, et al., 2006). All studies involved pregnant adolescent patients (<19 years of age). Three studies required mothers to be free of any comorbid diseases including hypertension, diabetes, and HIV/AIDS (Castillo-Duran et al., 2001; Chan et al., 2006; Wheeler et al., 2011).Not all studies specified the following terms of pregnancy: multiple or previous births, use of prenatal care, or home environment/support system. Studies which did not exclude comorbid conditions simply included pregnant teenagers as their sample population.

Nutritional Status

Of the five studies, three reviewed maternal nutrition and dietary measures to assess the adolescent's intake (Castillo-Duran et. al., 2001; Chan et. al., 2006; Wheeler et. al., 2011). Two of these studies used a standardized dietary recall (Castillo-Duran et. al., 2001; Wheeler et. al., 2011). Chan et. al. (2006) used a study-specific food frequency questionnaire. Chan et. al. (2006) surveys were geared to gather subjective data on specific nutrient intake during the mother's gestation period. This allowed the researchers to not only assess for compliance amongst their studies, but provided insight into the diets of their study subjects. All of the studies also included nutrient serum levels that were completed through blood draws and plasma analyses. An additional study (Meier et al., 2003), also provided information on specific maternal serum levels but no information on dietary questionnaires, surveys, or recalls.

In two studies, subject data provided was collected upon enrollment and compared with data from a later date (Castillo-Duran et al., 2001; Chan et al., 2006). Of the three studies (Castillo-Duran et al., 2001; Chan et al., 2006; Wheeler et al., 2011), only one showed significant effects on subject-reported intakes (Chan et al., 2006). It was suggested that dietary supplementation with calcium rich dairy facilitated an increase in vitamin D intake as well. These gains not only improved the mothers' diet (Chan et al., 2006), but did so with no negative effects on maternal weight, height or blood pressure during pregnancy. Zinc supplementation proved to have no effect on reported dietary intake in adolescents (Castillo-Duran et al., 2001).

The last study did not compare their findings to baseline and did not compare food frequency to intake, but to pregnancy outcomes, of which there was no significant association or effect (Wheeler et al., 2011).

Serum nutrient levels were also examined for influence on maternal and fetal outcomes. Multiple measurements at different time periods during adolescent pregnancy to analyze serum macro- and micro- nutrient levels were evaluated for significant changes (Castillo-Duran et al., 2001; Meier et al., 2003). Two studies used a single serum value (Chan et al., 2006; Wheeler et al., 2011). In Chan et al. (2006), serum was taken at delivery, and in Wheeler et al (2011) serum was taken early in the 3rd trimester. Specific levels for the nutrient(s) in question were evaluated. Results reported varied on extra level information on macronutrients, micronutrients, minerals, and vitamins. One study in particular (Wheeler et al., 2011), examined the serum for plasma nicotine concentration to examine the tobacco exposure within their maternal population. Results indicate that no significant difference in nutrient serum levels were realized between zinc-supplemented mothers and a placebo (Castillo-Duran et al., 2001). Also, no significant difference in free fatty acid concentration in mothers in of varying body mass index (BMI) cohorts were found (Wheeler et al., 2011). On the other hand, Chan et al. (2006) found that serum folate levels were increased upon delivery in mothers whose diets were supplemented with dairy sources. A final study (Meier et al., 2003) used serum levels to analyze levels of iron deficiency anemia in pregnant adolescents. This particular serum level was not attributed to any specific intervention or associated with any increase/decrease in intake. Serum levels were solely used to discuss outcomes on birth weight. Results indicated that pregnant adolescents have significantly decreased serum iron levels throughout their pregnancies related to poor dietary intake and no identifiable interventions, except prenatal vitamins, were offered to improve serum iron levels.

Specific Effects on Birth Outcomes

The studies found during the course of this review evaluated zinc (Castillo-Duran et al., 2001), calcium (Chan et al., 2006), BMI associated weight gains (Nielsen, O'Brien, et al., 2006), fatty acid composition (Wheeler et al., 2011), and iron (Meier et al., 2003). Birth outcomes analyzed were primarily fetal birth weight. Secondary information about prematurity rates and pregnancy complications was also collected. This information is summarized by significance using direct quotes in Table 3.

Birth Weight

In all of the reviewed studies, fetal weight was categorized as LBW at $\leq$2,500 g at birth. Positive birth weight outcomes were considered desirable fetal birth weights above the category of LBW. Of the five studies reviewed, three of the studies supported positive birth weight outcomes (Castillo-Duran et al., 2001; Chan et al., 2006; Nielsen, O'Brien, et al., 2006), and two studies found no effect (Meier et al., 2003; Wheeler et al., 2011). Positive birth weight outcomes supported interventions for zinc (Castillo-Duran et al., 2001), calcium supplementation through dairy (Chan et al., 2006), and BMI appropriate weight gains (Nielsen, O'Brien, et al., 2006).

A randomized controlled-trial involving zinc supplementation in pregnant adolescents found that averaged birth weights did not appear to vary between dietary supplements and placebo, yet the incidence of SGA deliveries was increased in the placebo group (Castillo-Duran et al., 2001). A birth weight increase of 69 grams was observed between supplement and placebo average birth weights, and was not considered significant for the study's sample (Castillo-Duran et al., 2001).

On the other hand, calcium intake through dietary sources was strongly supported as a fetal birth weight indicator. Adolescent mothers that supplemented with dairy products yielded higher birth weights than adolescent mothers who were part of a control group or supplemented with just calcium-fortified orange juice. However, due to the lack of specific, standardized dietary recalls and complex nutrient combinations in the dairy group, results point to confounding factors that could possibly be responsible for the gains observed in birth weight. (Chan et al., 2006)

Gestational BMI also provided significant evidence that negative birth outcomes occur when adolescent mothers are categorized below the recommended BMI for age and do not adhere to the recommended gestational weight guidelines (Nielsen, O'Brien, et al., 2006). Risk of SGA and suboptimal birth weight were significantly and negatively associated with lower pre-pregnancy BMI, gestational weight, and maternal height (Nielsen, O'Brien, et al., 2006).

No associations or correlations were found for the effects of fatty acid composition (Wheeler et al., 2011) nor iron (Meier et al., 2003) interventions on birth weight. There appeared to be no significant differences in birth weight outcomes between the varieties of fatty acid compositions tested. Wheeler et al. (2011) found that 18% of their cohort population gave birth to SGA infants, but the number was not significant enough to differentiate between the percentile groups. Similarly, Meier et al. (2003) only observed three LBW infants $\leq$2,500 g from their study population. Two of these infants were from the placebo group. These results were not significant enough to definitively state the effect of iron intervention on birth weight.

Prematurity Rates

Positive prematurity rate outcomes were considered >36 weeks gestation. Of the studies reviewed, only zinc supplementation provided significant, positive evidence for dietary interventions in prematurity (Castillo-Duran et al., 2001). No significant difference in dietary supplementation with zinc was found in infants born between 32 and 40 weeks gestation. However, there was a significant amount of difference between the numbers of newborns born preterm between the groups. The supplemental group only yielded 14 preterm infants of the 249 newborns, while the placebo group yielded 30. (Castillo-Duran et al., 2001) This finding was considered significant. None of the other studies reviewed reported any effect on prematurity rates related to dietary interventions in adolescent mothers.

Pregnancy Complications

None of the studies reviewed reported any significant effects related to pregnancy complications amongst intervention and control groups with regard to dietary or nutrient interventions aimed at pregnant adolescents. Complications were considered any maternal or fetal developments that compromise the delivery of the newborn. Examples of these includes but are not limited to spontaneous abortion, fetal demise, or fetal death.

Other Effects Discussed

Chan et al. (2006) provided additional conclusions regarding positive outcomes related to supplementation. Positive effects discussed included increased intake of vitamin D, serum folate, and maternal bone mineralization.

DISCUSSION

After careful analysis and organization of the information collected from the resulting studies, nutritional recommendations for teenagers were either strengthened, weakened, or were not affected by the data presented (Table 3). This initial review found that while none of the interventions provided significant negative effects, only three of the reviewed interventions (Castillo-Duran et al., 2001; Chan et al., 2006; Nielsen, O'Brien, et al., 2006) provided positive maternal fetal outcomes including birth weight. The remainder of the studies reviewed (Meier et al., 2003; Wheeler et al., 2011) found that the interventions provided non-significant effects on birth weight. These effects are further discussed below.

Weak or No Evidence

Non-significant birth weight outcomes were observed by two studies during the course of this initial review (Meier et al., 2003; Wheeler et al., 2011). Interventions related to fatty acid dietary composition (Wheeler et al., 2011) and iron supplementation (Meier et al., 2003) were non-conclusive. While the differences amongst the control and intervention groups were not enough to claim significant effects on birth weight, the studies provided insight into which interventions require further research.

Strong Evidence

The studies which provided strong evidence for the effects of dietary interventions on fetal birth weight outcomes resulted in support for increased maternal nutrition, decreased prematurity in infant deliveries, and improved maternal bone mineralization (Castillo-Duran et al., 2001; Chan et al., 2006; Nielsen, O'Brien, et al., 2006). One additional study found a decreased incidence of iron-deficiency anemia (Meier et al., 2003), but had no correlations with birth weight.

Calcium Supplementation Intervention

The most effective intervention related to improving maternal nutritional status was the inclusion of calcium supplementation and dairy intake into the diets of adolescent mothers. Positive effects were seen in overall birth weights of infants of adolescent mothers, and nutritional status and bone mineralization were also greatly improved in this population (Chan et al., 2006). These results are consistent with previous results that focused on calcium supplementation in high risk populations. (Villar & Repke, 1990). Results concluded that calcium supplementation correlated with positive outcomes on birth weight and decreases in the incidence of preterm and spontaneous delivery in adolescent pregnancy. However, the interventions reviewed in Chan et al. (2006) reported problems with supplementation delivery and participant adherence. These issues may have been confounded factors which influenced the reported dietary intake of the participants in the study.

Zinc Supplementation Intervention

Other notable interventions that provided positive nutritional outcomes for the mother include zinc supplementation (Castillo-Duran et al., 2001). While serum levels of zinc remained unaffected during adolescent pregnancy, the supplemented mothers had an average birth weight of 3,319g while the placebo mothers averaged at 3,250g (Castillo-Duran et al., 2001). Likewise, the proportion of LBW was significantly decreased in the group that was supplemented. There was no difference or association found with or without zinc supplementation and the effects on pregnancy complications. Dietary interventions that include zinc supplementation provide insight into singular effects on birth outcomes. Further research must be done in terms of pregnancy complications related to zinc supplementation. Results indicate that despite low zinc intake in pregnant adolescents, they were still able to sustain a normal pregnancy (Castillo-Duran et al., 2001). Related studies have found conflicting data points on zinc intake and its influence on adolescent pregnancy outcomes. Fully understanding the effects of zinc in adolescent pregnancy is crucial before deciding on a definitive intervention that increases adolescent prenatal zinc intake.

BMI Appropriate Weight Gains

The most important outcomes regarding BMI weight gains as they affect birth outcomes were significant, but not the most significant of the three positive evidence studies. The significant results found that the most beneficial BMI related-weight gains as they pertain to birth weight were related to adolescents of the low or low-average BMI mothers. Mothers of average BMI or above witnessed no significant effects on birth weight outcomes. Mothers in the highest BMI weight gain category produced normal birth weight outcomes, but were also cautioned because of possible future health risks to the newborn’s growth and development (Nielsen, O'Brien, et al., 2006). This suggests that more research needs to be done in terms of positive and negative outcomes of increased birth weight and recommendations for maternal adolescent pregnancy weight gains.

Summary

Strong evidence supports the use of calcium supplements (Chan et al., 2006), zinc supplements (Castillo-Duran et al., 2001), and BMI appropriate weight gains in mothers (Nielsen, O'Brien, et al., 2006). This information can further support dietary supplements during the pre-conception period as an intervention to prevent LBWs in high risk adolescent populations. However, this initial review provides mainly a background glance at the information on positive interventions within the adolescent population. Further research needs to be conducted not only on the specific interventions, but how these interventions affect the growing adolescent and other adolescent pregnancy outcomes.

LIMITATIONS

This literature review is subject to multiple limitations. Beginning with the search process, “adolesc* OR teen*”, “nutri*” OR “diet*”, “pregnan*” OR “prenatal”, and “outcome*” provide a wide variety of results which all needed to be sifted through to find pertinent studies related to the focus of this review. In completing these searches, there is the possibility that the key search terms were too broad and needed further description. To counteract this fact, multiple searches were conducted. However, this again provides the dilemma that possible studies were excluded during individual review of available research. This limits the available research used to create this literature review on successful interventions.

Additionally, the research reviewed all provided different interventions with no duplicated research. While this increases the variety of interventions reviewed, the research was not supported or denied by another article in this study. Individual studies provided information on prior research that supports or disagrees with the outcomes of their study. Duplicated research could have provided some valuable insight into items like possible confounding factors, inconsistency, successful methods, etc.

This initial review only provided five studies, with varying methods of collection. Inconsistencies between data collection and population sample could have caused discrepancies in data interpretation. Half of the studies collected were randomized control trials (Castillo-Duran et al., 2001; Chan et al., 2006; Meier et al., 2003), and the other half were observational/retrospective trials (Nielsen, O'Brien, et al., 2006; Wheeler et al., 2011). Furthermore, each study was completed in a different global locale and ethnic, environmental, and diversity factors were not considered as confounding factors.

Strengths and limitations of individual reviewed studies are outlined in Table 1.

RECOMMENDATIONS FOR NURSING

While none of the studies discussed provided specific nursing outcomes or implications, the duty of nurses in terms of this research is crucial. The role of professional nurses is not only to heal the physical wounds but to motivate, advocate, and educate our patients about their health. The information collected here can be used for nursing research, education, and practice. In combining nursing research, education, and practice, best practices can be implemented to prevent LBW consequences and develop effective interventions for this high risk population.

Nursing Research

As both a national and global objective, many studies have investigated varying interventions to answer the consequences and repercussions of adolescent pregnancy. Nutritional interventions, programs, social supports, and prenatal education interventions are all key areas of interest. Much of this research is geared towards finding individual supplementation that can alleviate maternal and fetal mortality and morbidity. Interventions are generally geared towards supplementation in a pill form, versus bioavailable sources of vitamins needed to support a healthy adolescent and a healthy pregnancy.

Discovering which interventions work best in this high-risk population will allow for new, improved, and specific interventions to be developed to combat the prevalence of LBW amongst adolescents. This particular study found that one of the strongest interventions reviewed was the implementation of dairy into adolescent prenatal care. This intervention not only had positive outcomes in birth weight, but also provided positive maternal nutritional status at the time of delivery.

Conducting further research on similar interventions of bioavailable nutrients for pregnant adolescents, especially in high risk populations, has the potential to discover similar effects of bioavailable nutrition versus supplementation. Furthermore, as none of the studies reviewed were nursing related articles, nursing research conducted can provide a new perspective on best practices for nurses in the health care setting.

Nursing Education

Educated, professional nurses are in high demand in the United States. In order for hospitals to reach Magnet status, they must employ a certain percentage of BSN-educated graduates (American Nurses Credentialing Center, 2014). While there are many pathways to becoming a nurse, the BSN-educated nurse is often associated with critical thinking and best patient care practices. Understanding interventions that work best within specific patient populations is part of this hallmark. In relation to this topic, importance is placed on nurses in the obstetric, pediatric, neonatal, and community setting. These nurses, specifically, should consider taking a specific continuing education credit to ensure that tailored care can be effective for pregnant adolescents.

As pregnancy is a sensitive topic for many teenagers, nurses need to be prepared to assist and answer questions that their patient may have. Nursing topics can potentially include "Adolescent Nutrition during Pregnancy", "The Maternal Adolescent and Effective Dietary Interventions", and "Critical Dietary Intakes related to Adolescent Pregnancy Outcomes".

While this study did not particularly focus on the psychosocial experience of the pregnant adolescent, this topic is extremely important as well. Psychosocial stressors can impair delivery of care. Nurses need to understand not only how to identify stressors present in their adolescent mothers, but also how to answer and alleviate the stressors.

Nursing Practice

The results of this review have many implications for nursing practice. Nurses are required to educate individuals about health care conditions and to provide care supported by evidenced based practice. This review explores adolescent nutrition beyond the general requirements and asks how health care providers can best gear educational objectives for a population that lies out of the standard prenatal requirements.

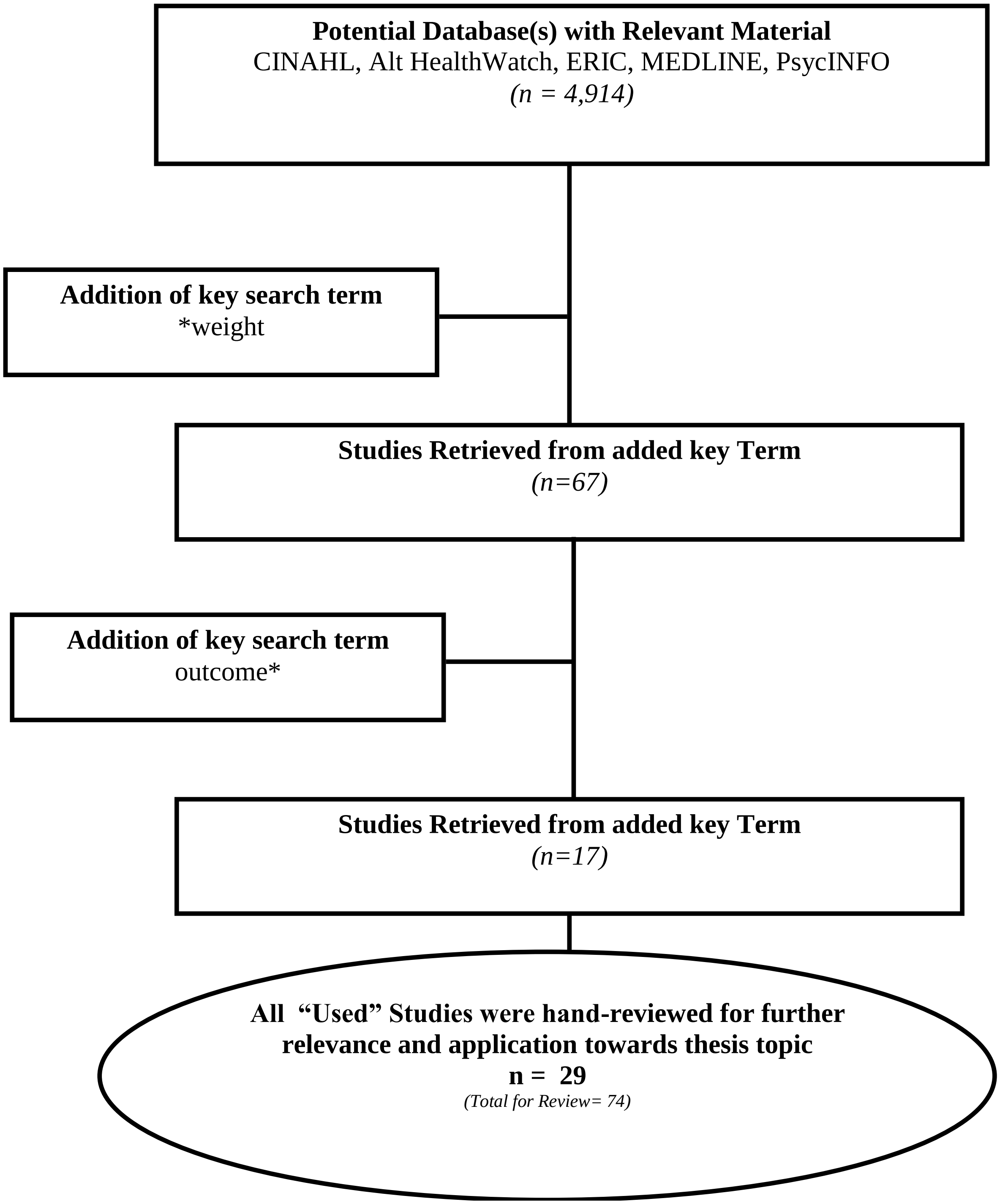
For nurses who have frequent encounters with the topic of adolescent pregnancy, dietary information is vital for both the health of the mother and her child. Promoting optimal nutrition to answer the needs of the growing adolescent and her pregnancy may be the key to achieving both the national and global objectives. Adolescent mothers, who receive nutritional education during their pregnancy, are more likely to maintain their nutritional status and improve their nutritional knowledge for subsequent pregnancies (Oliva et al., 2008).

In addition to health related education, nursing care can implement specific dietary plans for the hospitalized adolescent who is believed to be pregnant. Education can focus on a visual and gustatory example of foods required for the adolescent. Provision of educational materials and demonstration of nutritional foods will allow the adolescent to take charge of their own health, even beyond the course of the pregnancy.

CONCLUSIONS

In conclusion, this literature review was purposed to analyze the effect of dietary interventions on adolescent pregnancy birth weight outcomes. Some significant evidence was found for three studies supporting the positive birth weight outcomes for supplementation of zinc, calcium, and BMI-specific weight gains for adolescents. No significant evidence was provided on the effect of iron and fatty acid composition on birth weight outcomes. However, due to limitations related to study findings further research needs to be conducted and analyzed for a more definitive dietary recommendation. The information discovered can be used to develop best practices in nursing and future adolescent-specific interventions.

APPENDIX A: FIGURE



Key Search Terms: Nutrition*, Adoles* , Pregnan*
Limiters: Publish date 2000-2013, English Language, Peer-Reviewed

Figure 1: Initial Proposal Consort Diagram

APPENDIX B: TABLES

Table 1: Comparison of Interventions

Citation	Study Design	Subject Eligibility Criteria	Intervention	Results	Strengths/Limitations	Nursing Implications
(Castillo-Duran et al., 2001)	Double blind, randomized control trial (Zn supplementation vs. lactose placebo) Before follow-up, 804 pregnant adolescents were recruited to take part in the study. After follow-up nonadherence, 297 mothers were dropped from the study and only 507 mothers stay through to the end of the study.	• Prenatal care began before 20 weeks gestation • Mother < 19 years of age during estimated delivery date • Exclusion criteria included ○ Chronic disease ○ Drug Abuse ○ Mental Retardation ○ Illiteracy ○ Pregnancies related to rape or incest ○ Failure to participate in follow-up or take 50% of capsules during study	Subjects were divided into two groups: 1. Control: daily placebo capsule filled with lactose 2. Supplement: daily 20 mg of Zinc All subjects received 40 mg of iron sulfate in addition to control/supplement	• Only 6 of the 249 Zn supplemented mothers birthed LBW (<2500 g) babies, compared to 16 of the 258 placebo mothers birthed. • 69 g increase in birth weights of prenatal Zn supplemented infants compared to placebo • 5 in the Zn group, and 7 in the placebo, had spontaneous abortions	• **Limitations** - 297 mothers excluded related to follow-up non-adherence - Mothers taking 50-100% of capsules included and not necessarily separated based on adherence • **Strengths** - Multiple fetal and maternal outcomes reviewed - Demographics of mothers also reviewed and compared in results - Baselines reviewed and compared with end of study results - Dietary recalls performed on randomized subjects to observe any possible dietary differences between groups	Study did not specify particular nursing implications, but did provide recommendations for future practitioners. "positive effect of zinc supplementation during pregnancy on decrease rate of low birth weight and the risk of prematurity." (p. 722) "We recommend zinc supplementation or zinc fortification to the diets of …pregnant adolescents." (p. 722)
(Chan et al., 2006)	Randomized Control trial manipulating the diets (Control, Calcium Supplement Orange Juice, or Dairy) of pregnant adolescent mothers	• Upon enrollment in the study mothers needed to be before 20 weeks of gestation estimated as per their last menstrual period and confirmed by an ultrasound • Mothers were all between 15 and 17 years of age • Exclusion criteria included ○ Hypertension ○ Diabetes ○ Renal/Liver Disease ○ Alcohol use ○ Tobacco use ○ Medication use that affect Ca metabolism	Adolescent mothers were randomly selected to be in one of three groups • Control: Mothers assumed their "usual diet" (p. 566) • Calcium Fortified: Mothers were to consume their diet alongside. Half way through the study, half of the mothers in this group were also assigned calcium carbonate tablets to keep up with Ca intake of those in the diary group. • Dairy: Mothers were educated on foods that contained calcium, and were told to consume at least four servings a day.	"birthweights of the infants in the diary group (3,517 $\pm$ 273 g) were heavier than the birth weights of the infants in the control (3,277 $\pm$ 177 g) and orange juice plus calcium (3,292 $\pm$ 165 g) groups" (p. 568) • No significant birth weight difference between control and orange juice plus calcium. • "All infants had similar length, head circumference, and BP" (p. 568) • "Only the adolescent mothers on dairy products had the heavier newborn compared with	• **Limitations** - Orange juice supplement group had half participants change mechanism of delivery related to nonadherence. This was done to accomplish the required daily intake matching that of the dairy group - Due to the nature of the study, it's hard to attribute "which nutrient or combination of nutrients was responsible for the infant's gain in birth weight." (p. 568) • **Strengths** - Compliance was monitored weekly - Study explored the difference between natural calcium sources versus that of fortified ones - Multiple fetal and maternal	No specific nursing implications were discussed, but new recommendations explored in nutritional recommendations for adolescent mothers "nutritional supplementation in pregnant women who have marginal dietary status has resulted in high maternal weight gain, improved newborn birth weight, and decreased prevalence of low birth weight infants." (p. 569) "In adolescent pregnancy, low or inadequate weight gain (less than 4.3 kg by 24 weeks of gestation) is associated with preterm delivery. Protein and energy supplementations in

Citation	Study Design	Subject Eligibility Criteria	Intervention	Results	Strengths/Limitations	Nursing Implications
			All mothers were counseled on appropriate prenatal nutrition	controls and mothers on orange juice plus calcium" (p. 568)	outcomes explored - Study consistently checked in with subjects on regular intervals	normal pregnant women have shown no effect on newborn's birth weight." (p. 568) "In our study, diet supplement with dairy products during adolescent pregnancy increased … the newborn birth weight… without increases in lean or fat mass. Calcium diet supplemented with dairy products improved the mothers' diet without affecting their weight, height, or BP during pregnancy." (p. 568)
(Nielsen, O'Brien, et al., 2006)	Retrospective medical chart review of African American adolescent mothers receiving prenatal care.	All participant information was collected from adolescent mothers receiving care from the Maternity Center East clinic associated with Johns Hopkins Hospital. • $\leq$ 17 years at conception	No active intervention used. Researchers instead classified women into groups by BMI and inspected birth outcomes of each group. Birth outcomes were inspected and correlated with BMI groups to determine significant results	Of the 815 adolescents reviewed, 711 delivered at term. For mothers below normal BMI or in the lower half of the recommended BMI, birth outcome results were significantly lower • All other mothers received similar average birth weights "Further gains were not clearly beneficial, particularly for infants of high-BMI mothers." (p. 183) "Risk of SGA and suboptimal birth weight were significantly and negatively associated with pre-pregnancy BMI, gestations weight gain, and maternal height." (p. 185)	• **Limitations** - "significance of further improvements in birth weight from gains in the upper half of the recommended ranges was inconsistent." (p. 186) - "differences in the rates of (SGA and suboptimal birth weights) between those who gained in the lower half and those who gained in the upper half of the recommended ranges were also inconsistent." (p. 186) • **Strengths** - Data showed strong significance for positive birth weight outcomes in BMIs that ranged below the recommended values - Provides a strong backing in the importance of gestational weight gain education for adolescent mothers	"adolescents entering pregnancy underweight or at average weight should be counseled to gain within the recommended ranges, whereas overweight adolescent need support to avoid excessive gestational weight gain." (p. 183) Provides non-specific guidance on gestational weight education in adolescent teenagers, particularly in mothers who lie in the lower BMI categories.
(Wheeler et al., 2011)	500 pregnant adolescents in the UK were identified by study-specific	Pregnant adolescents were identified from antenatal screening by study-specific midwives.	No particular intervention was taken.	"Maternal plasma *n-3* LCP status during the third trimester is not associated	• **Limitations** - Due to unreliable food composition data, less rich	While this study did not provide specific nursing interventions that could be

Citation	Study Design	Subject Eligibility Criteria	Intervention	Results	Strengths/Limitations	Nursing Implications
	midwives in 4 local hospitals. Adolescents provided blood samples, fish frequency questionnaire, and access to birth outcomes for principal component analysis for comparison.	**Inclusion Criteria** • 14-18 years of age • < 20 weeks gestation • Singleton pregnancy **Exclusion Criteria** • Inability to provide informed consent • Previous pre-eclampsia, clotting disorders, HIV/AIDS, haemoglobinopathies, pre-existing diabetes, renal disease, hypertension • Multiple gestations • History of 3+ previous miscarriages	Groups were analyzed by ethnicities, and subsequently split from the main cohort into a sub-cohort which provided all necessary information for analysis. Maternal plasma concentrations, fatty acids, and oily fish consumption were all compared across ethnicities to determine if there was any association between these habits and birth outcomes.	with the duration of gestation or fetal growth in pregnant adolescents deriving little or no *n-3* LCP from oily fish." (p. 608) More than 2/3 of adolescent mother's in the study reported eating less than 1 serving of oily fish per week. This particular report is below the UK's national standards. While studies suggest that oily fish may have some positive birth outcomes in adult gestation and pregnancy, this particular study reported no significant changes in birth outcomes for the pregnant adolescent.	sources of DHA (eggs, offal and meat) were unable to be assessed - All adolescents came from the same low-income, urban area (London and Manchester) of the UK, making the data less generalizable - There were few "ethical considerations (which) prevented collection of fasted plasma" (p. 608), which could have resulted in false fatty acid compositions. • **Strengths** - Provided new research that bolsters the fact that adolescents may need different nutrient requirements during pregnancy. As opposed adolescents, "recent meta-analyses of RCT in adults have suggested that supplementation with *n-3* long-chain PUFA extends the duration of pregnancy." (p. 601) - Although the study failed to provide regional diversity, ethnic diversity covered three subset populations (white, black, and other). - Study matched patient reported intake with blood serum levels to check bolster their results.	used, it did provide some good insight into education that could be critical in catering and focusing care in the pregnant adolescent.
(Meier et al., 2003)	"Randomized, double-blind clinical trial with placebo control." (p. 29) This study compared and contrasted adult and adolescent mothers in the primary outcomes of iron-deficiency anemia	Study eligibility for the adolescent subjects included: • 15-18 years of age • Primagravida "Adult women 19 years or older I their first or greater pregnancy" (p. 30) was the criteria for the adult mothers.	"Eligible adult and adolescent participants were randomized to receive once daily in a double-blind fashion either an oral iron supplement of 200 mg of ferrous sulphate … or a placebo." (p. 30)	"In adolescents, 4 of 20 (20%) iron supplemented patients, and 10 of 17 (59%) receiving placebo developed IDA." (p. 31) "in both age groups the incidence of IDA was significantly reduced in iron	• **Limitations** - Primarily focused on the prevalence of IDA in pregnancy, and interventions to prevent it - Some results collected were non statistically significant due to the low power to detect an effect	IDA affects many adolescents worldwide. However, the findings in this study suggest that despite normal levels in the adolescent during pregnancy, supplementation may still be required. However, in "mild and

Citation	Study Design	Subject Eligibility Criteria	Intervention	Results	Strengths/Limitations	Nursing Implications
	and birth outcomes.	Mothers were excluded from the study • IDA upon first prenatal visit • These mothers were still offered treatment	"All participants also received 1 mg of folic acid daily" (p. 30) and were asked to abstain from any other supplemental vitamins or minerals with the exception of fluoride Labs were performed three times throughout the study: upon enrollment, at 24-28 weeks, and before delivery (36-40 weeks). Labs included serum ferritin and hemoglobin assessed from the venous blood.	treated patients compared to placebo treated patients." (p. 31) "mean gestational age at the time of delivery … was not significantly different between iron and placebo treated patients." (p. 31) "Only three infants were less than 2,500 g at birth, one from the iron group and two from the placebo group." (p. 31) None of the infants birthed in this study required NICU care. "The incidence of IDA in our study was higher in adolescent than adult pregnancies" (p. 32) "Our study was not large enough to effectively evaluate the potential association of IDA with fetal morbidity and mortality as suggested in some reports." (p. 33)	• **Strengths** - Explored IDA as a possibility for maternity and infant morbidity and mortality - Discussed the prevalence of IDA during pregnancy and the effects of supplement intervention - Directly compared outcomes of adolescents and adults	moderate iron deficiency during pregnancy, the importance of this goal to maternal and neonatal health remains unclear." (p. 32) Findings from the study provide a good starting place for nursing researchers to investigate the importance of iron supplementation in adolescent pregnancy, but it does not provide any definitive results of its own.

Table 2: General Outcomes Reviewed in Each Study

Citation	Birth Weight	Maternal Study-specific Nutrient Serum Level	Maternal Nutrition and Dietary Measures	Prematurity/Gestation Rates	Pregnancy Complications
(Castillo-Duran et al., 2001)	X	X	X	X	X
(Chan et al., 2006)	X	X	X		
(Nielsen, O'Brien, et al., 2006)	X			X	X
(Wheeler et al., 2011)	X	X	X	X	X
(Meier et al., 2003)	X	X		X	X

Table 3: Specific Birth Outcome Results of Each Study

Citation	Intervention/ Experimental Group	Birth Weight	Prematurity Rates	Pregnancy Complications	Other	Significant Effects
(Castillo-Duran et al., 2001)	Zinc supplemental pill and placebo	• "Supplement group presented a birthweight of 3,319 ± 460 g compared with 3,250 ± 514 g in the P group (NS)." (p. 715) • "Proportion of LBW (<2,500 g) in the supplement group was significantly lower than in the placebo group" (p. 715)	• "Prematurity rate was lower in the supplemental than in the placebo group." (p. 715)	• "No effects on pregnancy complications … were found." (p. 715)		• **Positive (Desired)** Birth weight and Prematurity • **Negative (Undesired)** None • **No Effect/Not Discussed** Pregnancy Complications
(Chan et al., 2006)	Subjects assigned to one of three groups: control, Calcium fortified	• "Calcium diet supplemented with dairy products during adolescent pregnancy			• "Calcium diet supplemented with dairy products during adolescent pregnancy	• **Positive (Desired)** Birth weight, Vitamin D and Folate levels, and maternal bone

Citation	Intervention/ Experimental Group	Birth Weight	Prematurity Rates	Pregnancy Complications	Other	Significant Effects
	orange juice, and dairy	resulted in … high newborn weight… compared with controls.” (p. 565)			resulted in higher maternal vitamin D and folate serum levels…and bone mineralization compared with controls.” (p. 565)	mineralization • **Negative (Undesired)** None • **No Effect/Not Discussed** Prematurity and Pregnancy Complications
(Nielsen, O'Brien, et al., 2006)	Prepregnancy/ Gestational BMIs categorized and birth outcomes analyzed	• “Mean birth weight in this population was 3062 $\pm$ 647 g, and 97% of the newborns had suboptimal birth weights (<3000 g)” (p. 185) • The “Risk of SGA and suboptimal birth weight (was) significantly and				• **Positive (Desired)** Birth weight • **Negative (Undesired)** None • **No Effect/Not Discussed** None

Citation	Intervention/ Experimental Group	Birth Weight	Prematurity Rates	Pregnancy Complications	Other	Significant Effects
		negatively associated with pregnancy BMI, gestational weight gain, and maternal height." (p. 185) • Mothers who gained less gestation weight for their BMI experienced increased "incidence of SGA and suboptimal birth weight." However, these rates appeared inconsistent amongst BMI groups (p. 186)				
(Wheeler et	Fatty acid	• "Consumption	• "Consumption		• "Lower	• **Positive**

Citation	Intervention/ Experimental Group	Birth Weight	Prematurity Rates	Pregnancy Complications	Other	Significant Effects
al., 2011)	composition and intake was determined through a questionnaire and blood test. Outcomes were compared across intake levels.	(of oily fish) was not associated with…lower customized birth weight, or higher incidence of small-for-gestational age birth." (p. 601)	(of oily fish) was not associated with a shorter duration of gestation" (p. 601)		proportions of *n-3* LCP in plasma lipids are not associated with greater risk of adverse pregnancy outcomes." (p. 601)	**(Desired)** None • **Negative (Undesired)** None • **No Effect/Not Discussed** Birth weight and prematurity rates
(Meier et al., 2003)	Participants received either an iron supplement or a placebo	• "Only three infants were less than 2,500 g at birth, one from the iron group and two from the placebo group."	• "Mean gestation age at the time of delivery was over 39 weeks and was not significantly different between iron and placebo treated patients." (p. 31)	• "No clinically significant perinatal morbitiy or mortality" (p. 31) • "None of the infants needed admission to the neonatal intensive care unit." (p. 31)	• "47% of all placebo-supplemented and 16% of all iron-supplemented patients exhibited iron deficiency anemia (IDA)" (p. 29) • "Nausea, vomiting, diarrhea, and constipation were not	• **Positive (Desired)** Decrease in IDA • **Negative (Undesired)** None • **No Effect/Not Discussed** Birth weight, prematurity rates, side effects, and maternal and

Citation	Intervention/ Experimental Group	Birth Weight	Prematurity Rates	Pregnancy Complications	Other	Significant Effects
					significantly different" (p. 29) • "No significant differences were seen in maternal or neonatal health." (p. 29)	neonatal health

*Blank boxes indicate no findings discussed in study.

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