Published in final edited form as:

MCN Am J Matern Child Nurs. 2011 ; 36(2): 120–126. doi:10.1097/NMC.0b013e3182057a13.

Nutrition Profiles of American Women in the Third Trimester

Susan Gennaro, RN, DSN, FAAN [Dean and Professor],

Boston College, William F. Connell School of Nursing: susan.gennaro@bc.edu

Babette Biesecker, MS, RN, FNP-BC,

Coordinator Adult Nurse Practitioner/Holistic Nurse Practitioner Program, New York University, College of Nursing

Heidi Collins Fantasia, PhD, RN, WHNP-BC [Post Doctoral Fellow],

Boston College, William F. Connell School of Nursing, Chestnut Hill, MA

Minh Nguyen, RN [Staff Nurse], and

Providence Health Center, Waco, Texas

David Garry, DO [FACOG]

Maternal-Fetal Medicine, Jacobi Medical Center, Bronx, NY

Abstract

Purpose—To develop a profile of common nutritional patterns among pregnant, African American women that will assist providers in identifying areas for improvement and change.

Study Design—This study was part of a larger NIH funded (R03NR008548-01) study that examined risk factors associated with preterm labor and birth in high risk and low risk African American women. Data were collected on high risk mothers (women experiencing preterm labor) prior to 34 weeks gestation and every four weeks until delivery. Data were collected on the low risk mothers beginning at 28 weeks and then every four weeks until delivery. For this study high risk and low risk groups were collapsed to examine food choices over time in all participants (n=58).

Methods—Nutrition intake was examined by conducting one 24 hour diet recall at each time point. Food models and portion size pictures were used to improve accuracy.

Results—Overall, dietary intake was suboptimal and micro and macronutrient intake during the third trimester did not vary. Energy (caloric) intake was inadequate with the time averaged probability of having inadequate caloric intake 64.4%. Protein intake was the most likely nutritional factor to be inadequate with a time averaged estimated probability of inadequate intake 25.1%. Micronutrient intake from food was also inadequate.

Clinical Implications—The persistence of sub-optimal nutritional intake during the third trimester supports the importance of continually assessing nutritional status throughout pregnancy, with a focus on caloric requirements and protein intake.

Keywords

Maternal nutritional physiology; prenatal nutritional physiology; nutritional requirements; pregnant women; vulnerable populations

Introduction

Pregnancy is a time of increased maternal nutritional requirements. Adequate maternal nutrition is an important component of a healthy pregnancy, and dietary deficiencies have been linked to negative fetal outcomes including premature birth prior to 37 weeks gestational age, low birth weight, and structural abnormalities such as neural tube defects (Keen, Clegg, Hanna, Lanoue, Rogers, Daston, et al. 2003; Wu, Bazer, Cudd, Meininger, & Spencer, 2004). Dietary deficiencies during pregnancy have also been linked to the development of maternal preeclampsia during pregnancy and obesity later in life (Frederick, Williams, Dashow, Kestin, Zhang, & Leisenring, 2005; Siega-Riz, Evenson, & Dole, 2004). In light of the importance of nutrition to positive maternal and neonatal outcomes, pregnancy represents a significant opportunity to evaluate adequate nutrition, healthy eating habits, and appropriate weight gain.

The federal government has been responsive to the opportunity to improve pregnancy outcomes by supporting programs aimed at enhancing nutritional status. Inadequate nutrition in pregnancy disproportionately affects low-income women and children. The U.S. federal government established The Special Supplemental Nutrition Program for Women, Infants, and Children in 1974. Commonly referred to as WIC, this program provides food and nutrition information to those who fall at or below 185% of the U.S. Poverty Income Guidelines, or an annual income of less than \$39,200 (WIC: The Special Supplemental Nutrition Program for Women, Infants, and Children, 2009). With a budget of almost \$7 billion, approximately 2 million pregnant, postpartum, and breastfeeding women participated in WIC for fiscal year 2008.

Other resources designed to improve pregnancy outcomes related to nutrition include Institute of Medicine (IOM) guidelines which have recently reevaluated established weight gain recommendations for pregnancy (IOM, 2009). Based on pre-pregnancy body mass index (BMI), these recommendations were not only aimed at optimizing the health of the infant by decreasing preterm and low birth weight infants, but also optimizing the health of the mother by attempting to address the fact that many women today are entering pregnancy overweight or obese (IOM, 2009). Approximately one third of pregnant women in the U.S. are obese (King, 2006), and African American women have disproportionately higher rates of obesity (Mehta, 2008). Additionally, African American women are over 50% more likely to experience a preterm delivery than White women (Martin, Hamilton, Sutton, Ventura, Menacker, & Kirmeyer 2006).

Weight gain during pregnancy is easier to measure than is nutritional intake, so not surprisingly weight gain often serves as a proxy for nutrition and much research has focused on this area. Stotland, Haas, Brawarsky, Jackson, Fuentes-Afflick, and Escobar (2005) investigated target gestational weight gain and revealed that a woman's belief about how

much weight to gain during pregnancy varied according to her pre-pregnancy body mass index (BMI) and provider recommendations. Women in this study with a high BMI aimed to gain more weight than the previously set 1990 IOM guidelines and women with a low BMI aimed to gain less than weight than recommended. Insufficient weight gain during pregnancy increased the risk of perinatal morbidity and mortality (Stotland et al, 2005). Only 30-40% of US women gain weight as clinically recommended, and a majority of pregnant women report not being told about appropriate pregnancy weight gain by their providers which leads to both inadequate and excessive weight gain (Abrams, Altman, & Pickett, 2000; Brawarsky, Stotland, Jackson, Fuentes-Afflick, Escobar, Rubashkin, et al, 2005). Psychosocial factors also appear to affect maternal weight gain. Higher depressive symptoms during pregnancy have been positively associated with weight gain that exceeds clinical recommendations (Webb, Siega-Riz, Dole, 2008).

How much weight a mother gains can affect her infant's health later in life. Maternal over nutrition and high infant birth weight has been associated with subsequent increased body mass index and obesity in childhood (Oken & Gillman, 2003; Parsons, Power, & Manor, 2001). Additionally, offspring of obese women who experience over nutrition are at greater risk of developing metabolic disorders such as diabetes and obesity (Boney, Verma, Tucker, & Vohr, 2005; Hillier, Pedula, Schmidt, Mullen, Charles, & Pettitt, 2007). Researchers have also suggested that inadequate maternal weight gain and under nutrition in pregnancy may lead to alterations in fetal tissues that predispose the infant to chronic conditions in adulthood, such as hypertension and diabetes (Gluckman & Hanson, 2004; Gluckman, Hanson, Cooper, & Thornburg, 2008).

The dietary intake of pregnant women has also been investigated. Among 44,612 Danish women, participants who reported a high fat diet in the second trimester, specifically red and processed meat and high-fat dairy products, had an increased risk of having a small for gestational age (SGA) infant as determined by a birth weight below the 2.5 percentile (Knudsen, Orozova-Bekkevold, Mikkelsen, Wolff, & Olsen, 2007). In the U.S., researchers suggested that increased maternal protein intake in the third trimester may be protective against excessive infant birth weight (Andreasyan, Ponsonby, Dwyer, Morley, Riley, Dear, et al. 2008). Among 1040 mother-infant pairs, an additional maternal protein intake of 10gms per day in the third trimester was associated with an average 17.8gm birth weight reduction among large birth weight infants but not low birth weight infants. Siega-Riz, Bodnar, & Savitz (2002) studied 2247 pregnant women to examine nutrient differences in a cohort of Caucasian and African American women during the second trimester of pregnancy. For both groups, low nutrient-dense foods were major sources of calories, fat, and carbohydrates. Although African American women consumed the highest amount of calories, Caucasian women had a greater intake of protein, iron, folate, and fiber.

Previous studies of maternal nutrition have only examined one point in time often during the second trimester (Siega-Riz et al., 2002; Webb et al., 2008). It is not known if patients who are assessed to have inadequate nutrition at a clinical prenatal visit are likely to continue to have inadequate nutrition throughout the remainder of the pregnancy. Given that African American women are disproportionately affected by obesity and poorer nutrition (Mehta, 2008), the purpose of this study was to examine common nutritional patterns among

pregnant African American women in the third trimester to determine the stability of nutrition and discover specific areas where health care providers can intervene to improve nutritional intake.

Study Design and Methods

This study was part of a larger NIH funded (R03NR008548-01) study that examined risk factors associated with preterm labor and preterm birth in high risk (women who experienced preterm labor) and low risk African American women. This paper reports the nutritional findings of the larger study and examines the stability of nutrition over time as well as the adequacy of nutrition for the entire sample (n=58).

Sample

The participants in this study were pregnant African American women receiving prenatal care at one hospital in the Northeast United States. All of the women in this study had a singleton pregnancy, and had no chronic disease(s). The sample was comprised of 58 pregnant women who were recruited into the study as they met the criteria to be in one of two groups of women. High risk pregnant women (n=38) were recruited because they were experiencing preterm labor prior to 34 weeks gestation. A woman was considered to actually be in preterm labor if she experienced more than 8 contractions in an hour, and had cervical changes. A smaller group of women (n=20) were recruited at around 28 weeks gestation if they were experiencing an uncomplicated pregnancy, were receiving prenatal care at the same academic health center and came from the same geographic location and socioeconomic background as women experiencing high risk pregnancies. The women in the low risk group were experiencing pregnancies in which no complications had been identified and they had no history of past obstetrical problems. All but one of the low risk women (19/20) gave birth at term. Of the 38 women who presented in preterm labor, 12 gave birth to a preterm infant. Therefore, of the 58 women in this study there were a total of 13 preterm deliveries (31% of women who had preterm labor delivered preterm) at an average gestational age of 32.1 weeks (SD =4.0). Given that both high risk and low risk women had preterm infants and that so many high risk women went on to deliver at term, nutrition was examined across all women in the study.

Sample Size Calculations

For this secondary analysis, sample size calculations were conducted using Nquery Advisor@4.0 sample size software, assuming a 5% type one error rate and two-sided confidence intervals. A sample size of 58 was determined to have good precision to estimate the proportion of subjects who are not meeting the recommended guidelines with respect to energy intake.

Data Collection Time Periods

Data were collected on the high risk mothers when they initially diagnosed as experiencing preterm labor prior to 34 weeks gestation and every four weeks until delivery. Data were collected on the low risk mothers beginning at 28 weeks and then every four weeks until delivery. Women were initially approached when they presented to the clinic for routine

care and followed at subsequent visits. Participants were given \$10 per visit as compensation for their time. Both the attrition and refusal rates were less than 5%.

Nutrition Intake was examined by conducting one 24 hour diet recall at each time point on what each subject ate. Diet recalls were used to record an accurate account of food eaten. Additionally, diet recalls are time efficient and eliminated participant burden of filling out long and complex food questionnaires. Food models were used to help subjects more accurately identify portion sizes. The target day for the diet recall was 24 hours in advance of the data collection point (which occurred Monday - Friday). This ensured that subjects were providing information about week-end days (Sundays) as well as week-days so a more complete picture of nutrient intake was obtained. Additionally, pictures of normal portion sizes were used so that subjects have a variety of ways in which they could determine portion sizes.

Participants were asked brand names of food whenever possible so that food composition could more be accurately examined in a computerized data base. This technique has been used successfully before with this research team and childbearing subjects were found to be quite thorough in recounting nutritional data (Gennaro, Fehder, York, and Douglas, 1997).

Information from the diet histories were analyzed using a computerized data base Food Processor (Esha Research, 2000) that contains over 2400 foods. Nutrient values assigned by the data base are in accord with information provided by the United States Department of Agriculture and over 550 other research sources. Fast foods from major franchises are included as are over 1182 convenience food items. The database is updated yearly.

All analyses were conducted in Stata 11.0, with two sided tests of hypotheses and a p-value < 0.05 as the criterion for statistical significance. Initial analyses were descriptive and included tabulation of categorical variables and calculation of means, standard deviations (SDs), and ranges of continuous variables. The method of generalized estimating equations (GEE) was then used to assess change over time in the nutrient variables. In addition, quasi-least squares (QLS) models were also implemented (Shults, Ratcliffe, & Leonard, 2007); QLS allowed for implementation of a Markov correlation structure that is appropriate for measurements that are unequally spaced in time. Graphical displays of the nutrient variables that were based on the QLS models were also obtained for selected nutrient variables: Scatter plots of nutrient values were constructed, that also included predicted values (with 95% CI values) based on the QLS models, versus time. (See figure 1)

The QLS analysis with a Markov correlation structure and robust standard errors indicated that there was no significant change in any energy intake variable over time. The proportion of subjects who failed to meet the recommendation with respect to each variable *at any measurement occasion* was then computed. Exact 95% confidence intervals (CI) for the proportion of expectant mothers who failed to meet the recommendation at any measurement occasion for each nutrient category were also calculated.

The time averaged probability of failing to achieve the recommendation with respect to each intake variable was then estimated by fitting a logistic quasi-least squares (QLS) model that allowed for adjustment for the potential correlation amongst the repeated measurements on

each subject. Because the initial QLS models had failed to identify a significant change over time in any intake variable, the logistic QLS models included a constant only, which allowed for estimation of the probability of failure to achieve the recommendation, averaged over the multiple measurements on each subject. The time averaged probability could be viewed as an estimate of the probability that subjects fail to achieve the recommendation averaged across time within the subjects.

Results

The average age of the sample was 23 (standard deviation [SD] = 5.7, most mothers were single (n=46, 79.3%) and most were multiparas (n=45, 77.6%). Almost half of the women in this study reported an income of less than \$5,000 a year with only 6 women (10.3%) reporting incomes over 25,500 a year. The average BMI at 28 weeks was 29.4 (SD =5.9, range = 18.6 – 45.7) and included pregnancy weight, as pre-pregnancy BMI measurements were not available. Macronutrients, or nutrients that supply energy (IOM, 1990) included protein, fat, and carbohydrates.

Energy Intake

The average caloric intake at 28 weeks was 2,936 calories (SD 1446.7). The recommended caloric intake for women in the third trimester is approximately 2,855 (ADA, 2010) and 43 of 58 (74.1%, exact CI=[61.0%, 84.7%]) of subjects at some time had less than the recommended caloric intake. The time averaged estimated probability of having less than the recommended daily kilocalorie intake at any measurement occasion was 64.4%. Intake above 4000 would be considered over-consuming and 17 of 58 subjects (29.3%; exact CI = [18.1,42.7]) over-consumed at some time. The time averaged probability of over-consuming was 17.7%, so that subjects were more likely to have less than the recommended daily intake than they were to over-consume. Figure 1 details the recommended calorie intake at 28 weeks and displays those participants that fell above and below this value.

Protein Intake requirement during pregnancy

39 of 58 (67.2%, 95% Exact CI = [53.7%, 79.0%]) subjects at some time had protein intakes less than the recommended 1.1 grams per kilogram per day. The time averaged estimated probability of having a protein intake less than 1.1 grams at any measurement occasion was 24.6%.

Fat intake requirements during pregnancy

46 of 58 (79.3%, 95% Exact CI = [66.6%, 88.8%]) of the subjects at some time had fat intakes above the recommended 20-35% of total energy per day. The time averaged estimated probability of having a fat intake outside the recommended 20-35% of total energy per day at any measurement occasion was 27.2%.

Carbohydrate intake requirement during pregnancy

The recommended carbohydrate intake is 175 grams (IOM) and 18 of the 58 women (31.0%, 95% Exact CI = [19.5%, 44.5%]) had carbohydrate intakes less than the recommended amounts. The time averaged estimated probability of having a carbohydrate intake less than

175 grams at any measurement occasion was 8.2%. Energy and macronutrient values are displayed in Table 1.

Micronutrients from food

As well as examining adequacy of nutrition in major nutrient categories we also examined micronutrients obtained from food. Micronutrients are nutrients that are needed by the body in smaller amounts (IOM, 1990) and iron, folate, vitamins D, C, and E, and calcium were examined in this study. Although pregnant women also do take prenatal vitamins (PNV) we were interested in determining the adequacy of micronutrients from food intake alone.

Iron intake requirement during pregnancy

Iron intake in 48 of 58 subjects (82.8%, 95% Exact CI=[70.6, 91.4%]) was less than the recommended 27 milligrams of iron per day. The time averaged estimate probability of having a value at any measurement occasion less than the recommended 27 milligrams of iron per day was 33.2%.

Folate intake requirements during pregnancy

The recommended intake of folate during pregnancy is 600 micrograms per day and 52 of the 58 subjects (89.7%, 95% Exact CI = 78.8%, 96.1%]) had less than the recommended 600 micrograms of dietary folate equivalents per day. The time averaged estimated probability of having less than the recommended 600 micrograms of dietary folate equivalents per day at any measurement occasion was 36.8%.

Vitamin D requirements during pregnancy

The recommended intake of Vitamin D during pregnancy is 5 micrograms per day and 53 of 58 (91.4%, 95% Exact CI={81.0%, 97.1%]) of the subjects had less than this recommended intake. The time averaged estimated probability of having an inadequate intake at any measurement occasion was 36.1%.

Vitamin C requirements during pregnancy

46 of 58 (79.3%, 95% Exact CI=[66.7%, 88.9%]) of subjects had less than the recommended 85 milligrams per day. The time averaged estimated probability of having less than the recommended Vitamin C intake at any measurement occasion was 27.4%.

Vitamin E requirements during pregnancy

The recommended intake of Vitamin E is 15 milligrams of tocopherol per day but 57 of 58 (98.3%, Exact CI =[90.8%, 99.9%]) of subjects at some time had less than this recommendation. The time averaged estimated probability of having less than the recommended Vitamin E intake at any measurement occasion was 46.7%.

Calcium requirements during pregnancy

Among women < 19 years of age, the recommended intake of Calcium is 1300 milligrams per day but 9 of the 9 women who were <19 years of age (100.0%, Exact CI =[66.4%, 100.0%]) had less than this recommendation. The time averaged probability of not achieving

the recommendation with respect to calcium among women < 19 years of age was 46.6%. Among women $\geq$ 19 years of age, the recommended intake of Calcium is 1000 milligrams per day but 40 of the 47 women who were $\geq$ 19 years of age (85.1%, Exact CI =[71.7%, 93.8%]) had less than this recommendation. The time-averaged estimate of the probability of not achieving the recommendation with respect to calcium was 32.6% for women $\geq$ 19.

Limitations

This sample in this study was small and focused on only African American women, so the results may not be representative of other cultures and countries. Pre-pregnancy BMI values were not available, and therefore BMIs reported in this study represent those taken at enrollment and include some pregnancy weight. Additionally, women experiencing high risk pregnancies and normal pregnancies were analyzed together and comparisons between groups were not made.

Clinical Nursing Implications

The results of this study indicate that nutritional intake among participants was steady over the third trimester of pregnancy and for most women nutritional intake was inadequate. Although the third trimester has been documented to be a time of slower gastrointestinal function due to the effects of progesterone and the enlarging fetus (Knudsen, Lebech, and Hansen, 1995), nutritional status did not worsen over time but was steady throughout the third trimester of pregnancy. Therefore continued nutritional assessment in the third trimester may provide opportunities to identify nutritional inadequacies that still exist in later pregnancy.

In this study, as in other studies of American women, over nutrition was a problem. For a portion of women caloric intake was high despite inadequate micronutrients. However, there was still a significant group that was undernourished. Weight gain is an important clinical measurement that is monitored in all pregnancies, but does not provide a complete picture of overall nutrition. Therefore, providers should assess maternal diets in greater detail. Because both over and under nutrition in pregnancy can lead to adverse outcomes, pregnant women should be offered clear guidelines regarding caloric requirements for their pregnancy and guidance for making healthy food choices. For women with limited financial resources, the WIC program provides both food supplementation and nutritional counseling and clinicians should provide information to their patients regarding enrollment. Table 2 provides additional web-based resources for clinicians to assist in providing patients with nutritional information.

Fat was the nutritional value that was consistently higher than recommended for most participants, but protein was the nutritional value that was consistently inadequate. Low protein intake is of particular concern because inadequate maternal nutrition, including low protein intake, results in a defensive fetal response which may include decreased somatic growth and a decreased number of nephrons and neurons (Gluckman, Hanson, Cooper, & Thornburg, 2008). Maternal protein requirements in pregnancy are high and therefore can be difficult to meet. Providers can work with patients to select protein rich foods that are both available and can be easily incorporated into meals and snacks. Possible choices for an

additional serving of protein include nuts, beans, legumes, eggs, yogurt, tofu, milk, cheeses, fish, poultry, and meats. Dietary restrictions, food allergies, cultural influences, and personal and family food preferences all need to be considered when making recommendations for dietary change.

Micronutrient intake from food alone was inadequate for the majority of participants. For example, nearly 90% of participants had inadequate folate intake. Although prenatal vitamin (PNV) supplementation is commonly prescribed in pregnancy, not all women take PNVs consistently. Between 25-50% of women do not take prescribed vitamins on a regular basis due to forgetting and/or common side effects such as nausea and constipation (Bodnar, Tang, Ness, Harger, & Roberts, 2006; Jasti, Siega-Riz, Cogswell, Hartzema, & Bentley, 2005; Sullivan, Ford, Azrak, Mokdad, 2009). Given that dietary sources of micronutrients were consistently low, nutrition counseling for pregnant women should include and assessment of PNV intake and any reasons for inconsistent use. Providers should work with patients to formulate strategies to remember daily vitamins, and any gastrointestinal side effects should be acknowledged and corrected if possible.

Conclusions

The importance of maternal nutrition during pregnancy for both the mother and fetus is significant and is a central focus of prenatal care. The participants in this study had nutritional profiles that remained stable over the third trimester of pregnancy, suggesting that once an eating pattern was established, it remained that way until delivery. Therefore, continuing to evaluate eating patterns and adequacy of nutrition during the third trimester provides additional opportunities for education and interventions to improve dietary intake that can have a positive impact on maternal and fetal health.

Acknowledgments

NIH funded R03NR008548-01

References

- Abrams B, Altman SL, Pickett KE. Pregnancy weight gain: still controversial. *American Journal of Clinical Nutrition*. 2000; 71(suppl):1233S–1241S. [PubMed: 10799396]
- American Dietetic Association. ADA Nutrition Care Manual. 2010. Retrieved on January 12 2010 at: <http://www.nutritioncaremanual.org>
- Andreasyan K, Ponsonby A-L, Dwyer T, Morley R, Riley M, Dear K, et al. Higher maternal dietary protein intake in late pregnancy is associated with a lower infant ponderal index at birth. *European Journal of Clinical Nutrition*. 2008; 61:498–508.10.1038/sj.ejcn.1602552 [PubMed: 17136041]
- Bodnar LM, Tang G, Ness RB, Harger G, Roberts JM. Periconceptional Multivitamin Use Reduces the Risk of Preeclampsia. *American Journal of Epidemiology*. 2006; 164:470–477.10.1093/aje/kwj218 [PubMed: 16772374]
- Boney CM, Verma A, Tucker R, Vohr BR. Metabolic syndrome in childhood: association with birth weight, maternal obesity, and gestational diabetes mellitus. *Pediatrics*. 2005; 115:290–296.10.1542/peds.2004-1808
- Brawarsky P, Stotland NE, Jackson RA, Fuentes-Afflick E, Escobar GJ, Rubashkin N, et al. Pre-pregnancy and pregnancy-related factors and the risk of excessive or inadequate gestational weight gain. *International Journal of Gynecology and Obstetrics*. 2005; 91:125–131.10.1016/j.ijgo.2005.08.008 [PubMed: 16202415]

- Esha Research. The Food Processor. Oregon: Esha Publications; 2000.
- Frederick I, Williams M, Dashow E, Kestin M, Zhang C, Leisenring W. Dietary fiber, potassium, magnesium and calcium in relation to the risk of preeclampsia. *Journal of Reproductive Medicine*. 2005; 50:332–344. [PubMed: 15971482]
- Gennaro S, Fehder WP, York R, Douglas S. Weight, nutrition, and immune status in postpartal women. *Nursing Research*. 1997; 46:20–25. [PubMed: 9024420]
- Gluckman PD, Hanson MA. Maternal constraint of fetal growth and its consequences. *Seminars in Fetal and Neonatal Medicine*. 2004; 9:419–425.10.1016/j.siny.2004.03.001 [PubMed: 15691778]
- Gluckman PD, Hanson MA, Cooper C, Thornburg KL. Effect of in utero and early-life conditions on adult health and disease. *New England Journal of Medicine*. 2008; 359:61–73. [PubMed: 18596274]
- Hillier TA, Pedula KL, Schmidt MM, Mullen JA, Charles MA, Pettitt DJ. Childhood obesity and metabolic imprinting: the ongoing effects of maternal hyperglycemia. *Diabetes Care*. 2007; 30:2287–92. [PubMed: 17519427]
- Institute of Medicine. Nutrition during Pregnancy. Washington, DC: National Academies Press; 1990.
- Institute of Medicine. Weight gain during pregnancy: Reexamining the guidelines. Washington, DC: National Academies Press; 2009.
- Jasti S, Siega-Riz AM, Cogswell ME, Hartzema AG, Bentley ME. Pill count adherence to prenatal multivitamin/mineral supplement use among low-income women. *The Journal of Nutrition*. 2005; 135:1093–1101. [PubMed: 15867287]
- Keen CL, Clegg MS, Hanna LA, Lanoue L, Rogers JM, Daston GP, et al. The plausibility of micronutrient deficiencies being a significant contributing factor to the occurrence of pregnancy complications. *Journal of Nutrition*. 2003; 133:1597S–1605S. [PubMed: 12730474]
- King JC. Maternal obesity, metabolism, and pregnancy outcomes. *Annual Review of Nutrition*. 2006; 26:271–291.10.1146/annurev.nutr.24.012003.132249
- Knudsen A, Lebech M, Hansen M. Upper gastrointestinal symptoms in the third trimester of the normal pregnancy. *European Journal of Obstetrics and Gynecology and Reproductive Biology*. 1995; 60:29–33. [PubMed: 7635226]
- Knudsen VK, Orozova-Bekkevold IM, Mikkelsen TB, Wolff S, Olsen SF. Major dietary patterns in pregnancy and fetal growth. *European Journal of Clinical Nutrition*. 2007; 62:463–470.10.1038/sj.ejcn.1602745 [PubMed: 17392696]
- Martin JA, Hamilton BE, Sutton PD, Ventura SJ, Menacker F, Kirmeyer S. Births: final data for 2004. *National Vital Statistics Reports*. 2006; 55(1):1–104.
- Mehta SH. Nutrition and pregnancy. *Clinical Obstetrics and Gynecology*. 2008; 51:409–418.10.1097/GRF.0b013e31816fda53 [PubMed: 18463470]
- Oken E, Gillman MW. Fetal origins of obesity. *Obesity Research*. 2003; 11:496–506.10.1038/oby.2003.69 [PubMed: 12690076]
- Parsons TJ, Power C, Manor O. Fetal and early life growth and body mass index from birth to early adulthood in 1958 British cohort: longitudinal study. *British Medical Journal*. 2001; 323:1331–1335.10.1136/bmj.323.7325.1331 [PubMed: 11739217]
- Shults J, Ratcliffe SJ, Leonard M. Improved generalized estimating equation analysis via xtqls for quasi-least squares in Stata. *The Stata Journal*. 2007; 7:147–166.
- Siega-Riz AM, Bodnar LM, Savitz DA. What are pregnant women eating? Nutrient and food group differences by race. *American Journal of Obstetrics and Gynecology*. 2002; 186:480–486.10.1067/mob.2002.121078 [PubMed: 11904611]
- Siega-Riz AM, Evenson K, Dole N. Pregnancy-related weight gain – a link to obesity? *Nutrition Reviews*. 2004; 62:S105–S111.10.1111/j.1753-4887.2004.tb00079.x [PubMed: 15387475]
- Stotland NE, Haas J, Brawarsky P, Jackson RA, Fuentes-Afflick E, Escobar GJ. Body mass index, provider advice, and target gestational weight gain. *American College of Obstetricians and Gynecologists*. 2005; 105:633–638.10.1097/01.AOG.0000152349.84025.35
- Sullivan KM, Ford ES, Azrak MF, Mokdad AH. Multivitamin use in pregnant and nonpregnant women: Results from the Behavioral Risk Factor Surveillance System. *Public Health Reports*. 2009; 124:384–390. [PubMed: 19445414]

- Webb JB, Siega-Riz AM, Dole N. Psychosocial determinants of adequacy of gestational weight gain. *Obesity*. 2008; 17:300–308.10.1038/oby.2008.490 [PubMed: 19008871]
- WIC. The Special Supplemental Nutrition Program for Women, Infants, and Children. Retrieved October 29, 2009 from <http://www.fns.usda.gov/wic/WIC-Fact-Sheet.pdf>
- Wu G, Bazer FW, Cudd TA, Meininger CJ, Spencer TE. Maternal nutrition and fetal development. *Journal of Nutrition*. 2004; 134:2169–2172. [PubMed: 15333699]

Figure 1.
Kilocalorie intake

Table 1

Nutritional Component	Recommended Intake (28 wks)	Actual Intake(average)
Protein	1.1 gm per kg/day	86.73gms
Carbohydrate	175gms	377gms
Fat	20-35% total calories (80 gms)	119gms
Energy (calories)	2, 855	2,936

Table 2Suggested Websites for Clinicians:

United States Department of Agriculture: WIC Works Resource System: http://wicworks.nal.usda.gov/nal_display/index.php?info_center=12&tax_level=1

U.S. Department of Health and Human Services and U.S. Department of Agriculture Dietary Guidelines for Americans: <http://www.health.gov/dietaryguidelines/dga2005/document/pdf/DGA2005.pdf>

Institute of Medicine: Weight Gain During Pregnancy Guidelines: <http://www.iom.edu/Reports/2009/Weight-Gain-During-Pregnancy-Reexamining-the-Guidelines.aspx>