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Abstract

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Keywords

maternal nutrition; nutrition disparities; pregnancy; WIC; food and nutrient intake

Cover Page Footnote

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ABSTRACT

In an exploratory study, a convenience sample of 148 pregnant women was recruited from a WIC clinic in the southeast region of the U.S. to: 1) Examine and compare daily nutrient and food group intakes of WIC pregnant women to national guidelines, and; 2) Determine racial/ethnic differences in nutrient and food group intakes among WIC pregnant women. Women were selected for the study if they were: ≥ 18 y, in 2nd trimester of pregnancy, and if they spoke English or Spanish as a first language. Upon recruitment, participants were interviewed to collect information on their socio-demographics, including race/ethnicity. Additionally, 24-h diet recalls were conducted to collect information on average nutrient and food groups intakes of participants during pregnancy. Of the total participants, more than half self-identified as African American (59%), while the remaining reported being Hispanic (20%) and non-Hispanic White (22%). For nutrient intakes, women consumed folate, iron, and potassium below recommended amounts. In contrast, sodium was consumed above the recommendations for pregnancy. For food groups, intake of fruits and whole grains was limited. In comparison by race/ethnicity, specifically it was found that African American women were consuming higher amounts of carbohydrates, but lower amounts of potassium, vitamin A, and fiber in reference to non-minority group of non-Hispanic Whites. While, Hispanic women were consuming lower amounts of added sugar and animal protein than non-Hispanic Whites. Findings highlight the importance of prenatal nutrition education programs and interventions to improve dietary habits of low-income, racial/ethnic minority women. Inter-racial and ethnic differences exist in dietary intake patterns among low-income pregnant women, with African American women being at an increased risk for poor dietary habits and inability to meet nutrient requirements for pregnancy.

Keywords: maternal nutrition; nutrition disparities; pregnancy; WIC; food and nutrient intake

INTRODUCTION

Poor dietary habits during pregnancy significantly increase the risk for gestational diabetes, excess gestational weight gain (GWG), and macrosomia among infants (Crume et al., 2016; Guelinckx, Devlieger, Beckers, & Vansant, 2008; Campbell & Procter, 2014). Following the life course approach, policies and programs that promote healthy dietary habits during pregnancy are necessary for addressing the intergenerational cycle of maternal and childhood obesity and comorbidities (Dixon, Peña, & Taveras, 2012). In the life course framework, it is postulated that poor maternal dietary habits during pregnancy, which cause excess gestational weight gain, increase the risk of high infant birthweight and later, childhood obesity. Additionally, maternal health is also at risk as excess gestational weight gain may predict high postpartum weight retention and subsequent obesity (Nehring, Schmoll, Beyerlein, Hauner, & Von Kries, 2011). Some evidence also shows that maternal dietary intake is not only predictive of infant birthweight, but also infant body composition, such that increased dietary fat and carbohydrate intake is positively associated with neonatal adiposity (Crume et al., 2016). Considering this, promoting optimal nutrition during pregnancy has been endorsed as a key strategy in addressing obesity and improving quality of life for adults and children (Stang & Huffman, 2016). However, as a first step in developing effective prenatal nutrition interventions and programs, it is critical to have a clear understanding and knowledge of the nutrients and food intakes of pregnant women.

According to the Centers for Disease Control and Prevention (CDC), in 2015, approximately half of the pregnant women with full-term singleton infants exceeded recommendations for GWG (CDC, 2016). It is noted that the low-income and low-education levels are associated with an increased risk of excess GWG (Paul, Graham, & Olson, 2013; Olson & Strawderman, 2003; Pawlak, Alvarez, Jones, & Lezotte, 2015). For instance, in a study by Olson and Strawderman (2003), pregnant women with a family income <185% of the federal poverty line had greater odds of exceeding the IOM GWG range recommendations (OR= 2.59, 95% CI 1.6, 4.2, $P<0.001$). In a population-based study of Colorado pregnant women, researchers found that compared to women with >12 y of education, women with only 12 y of education had increased odds of excessive GWG (OR = 1.25, 95% CI 1.01, 1.44, $P<0.05$) (Wells, Schwalberg, Noonan, & Gabor, 2006).

Differences in GWG by racial/ethnic groups also vary. A review on the racial and ethnic differences in GWG found that approximately 48% of African American and 43% of Hispanic women gained weight above the IOM recommended range (Headen, Davis, Mujahid, & Abrams, 2012). Additionally, reviews of the racial and ethnic differences in obstetric and perinatal outcomes revealed that, compared to white women, African American women have an increased risk for food insecurity during pregnancy. Furthermore, they have an increased risk for pregnancy-related hypertension, gestational diabetes, caesarean and preterm delivery, and fetal demise (Bryant, Worjoloh, Caughey, & Washington, 2010; Willis, McManus, Magallenes, Johnson, & Majnik, 2014). Studies also show that the 'immigrant paradox' of having favorable birth outcomes despite the social disadvantages, is becoming irrelevant among Hispanic women with increased acculturation (Bryant et al., 2010; Ruiz, Dolbier, & Fleschler, 2006; Rosenberg, Raggio, &

Chiasson, 2005). Also, Hispanic women have a greater risk of developing gestational diabetes compared to non-Hispanic white women (Bryant et al., 2010; Pu et al., 2015).

The daily requirements of various micronutrients are higher during pregnancy. To meet the increased micronutrient requirements such as calcium, folate and Vitamin A, pregnant women are expected to increase their intake of nutrient dense foods such as fruits, vegetables, whole grains, and low-fat dairy. These expected changes in the diet are not always feasible, especially for low-income women, since nutrient-dense foods are generally more expensive than calorie-dense foods. Research on eating behaviors and knowledge, indicates that low-income and minority women, are at a higher risk for not meeting the additional vitamin and mineral requirements during pregnancy (Paul et al., 2013; Myles, Gennaro, Dubois, O'Connor, & Roberts, 2017; Bodnar et al., 2017; Siega-Riz, Bodnar, & Savitz, 2002). However, the literature is limited on eating pattern by food groups, and it is unclear to what extent minority women meet the daily requirements for vitamins and minerals during pregnancy.

The Special Supplemental Nutrition Program for Women, Infants and Children (WIC) is one of the major food assistance programs in the U.S. The program provides economic assistance to purchase selected nutrient rich foods; and WIC specifically targets low-income and at risk pregnant and breastfeeding women and young children. Hence, WIC offers a great opportunity to reach low-income, racial/ethnic minority pregnant women. For instance, according to the 2014 report, ≈1.6 million women were enrolled in the program. Also, 20% reported African American race, 59% reported white race, and 42% reported Hispanic ethnicity (Thorn et al., 2015). However, little is known about the foods and nutrient intakes of WIC pregnant women. This is a major information gap, considering knowledge on current dietary habits is important to develop an effective and tailored prenatal nutrition program. Thus, the primary objectives of this exploratory study are to: 1) Examine and compare daily nutrient and food group intakes of WIC pregnant women to national guidelines, and; 2) Determine racial/ethnic differences in nutrient and food group intakes among WIC pregnant women.

METHODS

A convenience sample of 148 WIC pregnant women in their second trimester (13-27 weeks) were recruited and interviewed to collect information on their daily dietary habits. The University of North Carolina at Chapel Hill and the University of North Carolina at Greensboro Institutional Review Boards approved the study. Women were recruited from the WIC clinic and were deemed eligible to participate in the study if they were: 1) ≥18 years of age; 2) 13-27 weeks pregnant (2nd trimester); and, 3) able to speak either English or Spanish. The WIC staff provided the study information to potential participants, and those who indicated interest, were introduced to the research staff. The research staff answered participants' questions and asked them to provide written consent to participate in one in-person and one telephone interview in an approximately 2-week period. The in-person interview was conducted at the time of recruitment in the WIC clinic. Interviews in English were conducted by research assistants, while Spanish interviews were conducted by a bilingual Hispanic outreach worker (fluent in English and Spanish). Prior to conducting this main study, a pilot study was conducted with 10 participants, to train the research team in interview techniques, and 24-h diet recall methods.

During the in-person interview, the first 24-h diet recall was collected. Participants were also asked questions regarding their food security status and socio-demographics, including age, income, race/ethnicity, and parity. Based on a self-report, participants were grouped into the following racial/ethnic categories: 1) African-American; 2) Hispanic; 3) Non-Hispanic White. The participants who did not report one of these categories were not included in the analyses. As a result, of the total 198 participants that were interviewed, data from 148 participants is included for this paper. The remaining 50 participants fell under the 'other' category i.e., Asian, Native American or mixed race, and were dropped from the analyses to avoid several small groups and empty cells for the analyses.

The second telephone interview date was scheduled at the end of the first in-person interview. The main purpose of the telephone interview was to conduct a second 24-hour recall. The date/day of the telephone interview was prearranged to ensure the two 24-hour diet recalls were conducted in a combination of one weekend and one weekday. Participants received grocery store gift cards as incentives for participating in interviews.

Dietary Intake Assessment

The 24-h dietary recalls were conducted using the multiple-pass, paper-pencil method (Conway, Ingwersen, Vinyard, & Moshfegh, 2003). Participants were asked to recall specific types and quantities of foods they consumed over a 24-hour period, from midnight to midnight on the previous day. During the first in-person 24-hour recall, to aid participants with recalling accurate estimations of the quantities of foods they consumed, food models, measuring spoons, glasses and bowls were provided. For the second 24-h recall, participants were encouraged to use a 2-dimensional booklet containing diagrams of concentric circles and square inch grids, as well as images of different sized serving utensils, which was given at the end of first in-person interview (Valencia & Stevens, 2007). Participants that reported ethnic or mixed dishes were asked to describe their recipes with all details relating to the ingredients, cooking methods, and portion size. Participants were not asked about the use of vitamins/minerals supplements.

Data from the first and second 24-h recalls were recorded and analyzed using the 2013 Nutrition Data System for Research (NDSR) software (Nutrition Coordinating Center, University of Minnesota, Minneapolis, MN). Quality check was conducted to ensure that foods, serving sizes, and recipes were entered accurately and completely. Of the selected 148 participants, 124 (84%) had completed both the in-person and telephone 24-hour recalls, while the remaining 24 (16%) participated only in the first in-person 24-hour recall. Of the 124 participants that completed both recalls, the combinations were as follows: 103 (83%) weekend and weekday; 19 (15%) two weekdays; and, 2 (2%) two weekend days.

The average daily intake of total calories, macronutrients, micronutrients, and servings from food groups was calculated for each participant with two 24-hour recalls. The data from participants with one 24-hour recall was left as is. Based on the recall data, daily intake of calories was estimated along with nutrient ratios (percentages of energy from fat, carbohydrates, protein, saturated fats) and daily intake of 21 individual nutrients for each participant. The recalls were also analyzed by 13 food groups including five main food groups of grains, vegetables, fruits, dairy, and meat.

Statistical Analyses

The socio-demographics, food security status, daily nutrient intake, and food groups data were analyzed using the SPSS Version 21.0 (IBM Corporation, Somers, NY). Descriptive statistics and frequencies were used to describe socio-demographic characteristics and food security status for the total sample. Chi-square analysis was used to test for differences in socio-demographics and food security status by race/ethnicity. The average daily intake of macronutrients (carbohydrates, proteins, fats), vitamins, and minerals were calculated and compared with the Dietary Reference Intake (DRI) values, or daily recommended amounts for pregnancy (Institute of Medicine, 2011).

Nutrients and Food Groups Analyses

As a first step, the nutrient intakes were adjusted for total calorie intake using the nutrient density method [(*X* nutrient intake) ÷ (total energy intake (kcal)) • 1000] (Willett, Howe, & Kushi, 1997). Next, to examine the normality of the energy-adjusted nutrients and food group data, the Kolmogorov-Smirnov test was conducted. Of the 21 nutrients, and 13 food groups tested, 5 nutrients (fat, carbohydrates, protein, animal protein, total sugars) and 2 food groups (total grains, refined grains) were normally distributed. To adjust for the skewed distributions of these nutrients and food groups, and maintain overall consistency in analyses, all the nutrients and food groups were divided by tertiles. Chi-square analysis was then used to examine the relationship between race/ethnicity (African Americans, Hispanics, and Non-Hispanic Whites) and nutrients or food group serving intakes by tertiles. Nutrient and food group servings that differed significantly at $P \leq 0.10$ between the three racial/ethnic groups were analyzed further using multiple logistic regressions.

The logistic regression was calculated to determine if race or ethnicity remained a significant predictor after controlling for socio-demographics that were significantly different between the three ethnic/racial groups. For the logistic regression, the nutrients and food groups by tertiles were further designated into two groups, by whether intake is encouraged or recommended to be eaten in moderation by the 2015 Dietary Guidelines for Americans. For instance, for fruits, the tertiles were coded as: highest tertile (0) vs. middle and low intake tertile (1), while for meat, the tertiles were coded as: low tertile (0) vs. middle and high intake tertile (1). Therefore, for each nutrient or food group as a dependent variable, the reference category (0) represented the better option of being in low tertile category for the moderation food groups, or the highest tertile category for the recommended food groups. The odds ratio explained the odds of not being in highest tertile for recommended nutrients/food groups, and the odds of not being in the lowest tertile for nutrients/food groups that are recommended to be limited in a healthy diet. The results were considered statistically significant at a *P*-value of ≤ 0.10.

RESULTS

The average age of participants in this study was 26 years old and approximately two-thirds had a monthly household income between $0–500 (Table 1). In this sample, 59% self-identified as African American, 19% reported being Hispanic, while the remaining 22% were non-Hispanic White women. As shown in Table 1, 57% were food secure (classified as either fully food secure or marginally food secure), while the remaining participants reported low or very low food security. Half of the participants were also receiving Supplemental Nutrition Assistance Program (SNAP, commonly known as Food Stamps) benefits. Most of the participants possessed a state driver's license; however, approximately one-third of the participants did not have a driver's license. For a majority (71%), this pregnancy was not planned.

In comparison, the three racial/ethnic groups differ significantly by marital status, household size, possession of a driver's license, having a first baby, and whether the pregnancy was planned (Table 1). A higher number of African American women reported being a single, divorced, or separated, and currently having an unplanned pregnancy. Of the three groups, Hispanic women were more likely to live in a large household of more than four people, to not have a driver's license, and to be primiparous.

Table 1. Socio-demographic characteristics overall and by race/ethnicity of WIC pregnant women (n=148)

	n (%)	Non-Hispanic White, n (%)	Hispanic, n (%)	African American, n (%)	*P*-value*
Age					0.191
18-24 y	71 (48)	14 (44)	9 (31)	48 (55)	
25-30 y	47 (32)	12 (38)	13 (45)	22 (25)	
31-41y	30 (20)	6 (19)	7 (24)	17 (20)	
Income Per Month[a]					0.182
$0–500	106 (72)	22 (69)	25 (86)	59 (69)	
$501–1000	29 (20)	9 (28)	2 (7)	18 (21)	
≥$1001	12 (8)	1 (3)	2 (7)	9 (11)	
Household Size					0.031
1-2 people	47 (32)	9 (28)	4 (14)	34 (39)	
3 people	51 (35)	11 (34)	9 (31)	31 (36)	
≥4 people	50 (34)	12 (38)	16 (55)	22 (25)	
Employment Status[b]					0.190
Employed	63 (43)	15 (47)	8 (28)	40 (46)	
Unemployed	85 (57)	17 (53)	21 (72)	47 (54)	
Education					0.247
Trade/High school or less	75 (51)	13 (41)	13 (45)	49 (56)	
More than high school	73 (49)	19 (59)	16 (55)	38 (44)	
Marital Status					<0.001
Married/living together	58 (39)	17 (53)	19 (66)	22 (25)	

Single/divorced /separated	90 (61)	15 (47)	10 (35)	65 (75)	
Food Security Status[c]					0.473
Secure	85 (57)	16 (50)	19 (66)	50 (58)	
Insecure	63 (43)	16 (50)	10 (35)	37 (43)	
Receives SNAP					0.737
Yes	75 (51)	18 (56)	15 (52)	42 (48)	
No	73 (49)	14 (44)	14 (48)	45 (52)	
Have a Driver's License					0.001
Yes	100 (68)	23 (72)	11 (38)	66 (76)	
No	48 (32)	9 (28)	18 (62)	21 (24)	
First Baby					0.007
Yes	63 (43)	14 (44)	5 (17)	44 (51)	
No	85 (57)	18 (56)	24 (83)	43 (49)	
Planned Pregnancy					0.003
Yes	43 (29)	14 (44)	13 (45)	16 (18)	
No	105 (71)	18 (56)	16 (55)	71 (82)	

[a]n=147, one person did not answer the question on the total household income;
[b]Employed group includes individuals who own their own business, work part-time or full-time;
[c]Secure: fully and marginally food secure; Insecure: low and very low food secure;
*Chi-square; SNAP: Supplemental Nutrition Assistance Program, commonly known as food stamps.

Nutrient Intake

The Table 2 provides the pregnancy Dietary Reference Intake (DRI) values or daily intake requirements of the nutrients for which values have been established. Overall, as indicated in table 2, the average total energy intake for the participants was 2177 kcal. The majority of protein intake was from animal sources with an average of 62 g, accounting for 71% of total protein. As shown in Table 2, the average intake of saturated and *trans* fat was 29 g and 3 g, respectively. In comparison, the average intakes of folate, iron, and potassium were below the DRI amount for pregnancy. Further, intake of sodium was high i.e., compare to the DRI limit of 1500 mg per day, average daily sodium intake among the study population was 3967 mg (Table 2).

Table 2. Descriptive characteristics of selected nutrient intakes for WIC pregnant women (n=148)

	Recommended Intake[a]	Mean	SD	Median	Min	Max
Total Energy (kcal)	–	2177	559	2172	1122	3934
Carbohydrates (g)	≥175	270	79	263	114	552
Total Sugars (g)	–	122	51	115	18	321
Added Sugars (g)	–	60	35	57	4	154
Total Fat (g)	–	86	30	84	26	209
Saturated Fat (g)	–	29	12	27	6	91
Cholesterol (mg)	–	317	177	290	25	1014
Trans Fat (g)	–	3	2	3	0.2	8
Monounsaturated Fat (g)	–	30	10	29	9	61
Polyunsaturated Fat (g)	–	20	9	19	5	44
Protein (g)	≥71	88	30	87	33	213
Animal Protein (g)	–	62	27	63	12	175
Plant Protein (g)	–	26	10	24	8	71
Dietary Fiber (g)	≥28	18	9	17	4	67
Vitamin C (mg)	65–75	123	105	98	5	643
Total Folate (mcg)	600	467	297	402	143	2857
Vitamin B_{12} (mcg)	2.6	6	4	5	0.8	39
Total Vitamin A (mcg)	700	1040	737	860	172	3843
Calcium (mg)	1000–1300	1044	426	1020	142	25367
Iron (mg)	27	17	7	15	5	48
Sodium (mg)	1500	3967	1378	3902	1177	9378
Potassium (mg)	4700	2668	1017	2512	834	7150

[a]represents the Dietary Reference Intakes or recommended daily intake requirements of the nutrients for which values have been established. Blank spaces indicate that the daily recommended intake amount is not established for that particular nutrient.

In comparison for total energy intake and macronutrient ratios by race/ethnicity, a significant difference was seen for percentage of carbohydrate and fat. Between the three racial/ethnic groups, the Hispanic women consumed a higher percentage of energy from carbohydrates (Non-Hispanic Whites: 50.6%, Hispanics: 51.1%, African Americans: 47.6%; $F_{145, 3}$: 2.68; P= 0.07). While, for African American women, a higher percentage of energy came from fat (Non-Hispanic Whites: 33.9%, Hispanics: 31.8%, African Americans: 35.6%; $F_{145, 3}$: 3.34; P= 0.03).

Of the 21 nutrients, 11 were significantly different by race/ethnicity in bivariate analysis (results not shown). After controlling for significant socio-demographics, race/ethnicity predicted the intake of 6 of the 11 nutrients (Table 3). African Americans had lower odds of being in the highest tertile of intake for carbohydrates compared to non-Hispanic Whites. While, as shown in Table 3, Hispanics had lower odds of consuming high amounts of added sugar when compared to non-Hispanic Whites. In the case of nutrients that are generally recommended to be consumed in higher amounts, in comparison to non-minority group of non-Hispanic Whites, particularly African Americans had greater odds of consuming lower amounts of plant protein, fiber, potassium, and Vitamin A (Table 3).

Table 3. Role of ethnicity in predicting intake of energy-adjusted nutrients among WIC pregnant women (n = 148)

Nutrient	Hispanics		African Americans		Hosmer-Lemeshow Statistic
	Odds of eating higher amounts (highest tertile)				
	OR	95% CI	OR	95% CI	
Carbohydrates (g)	1.26	0.41 – 3.85	0.41	0.15 – 1.10*	0.27
Total Fat (g)	2.09	0.58 – 7.51	1.37	0.46 – 4.03	0.83
Added Sugar (g)	0.24	0.05 – 1.06*	0.74	0.28 – 1.94	0.34
Sodium (mg)	0.59	0.13 – 2.56	1.72	0.59 – 4.98	0.47
	Odds of eating lower amounts (less than highest tertile)				
	OR	95% CI	OR	95% CI	
Total Grain (g)	0.40	0.12 – 1.36	1.35	0.46 – 3.90	0.04
Whole Grain (g)	0.72	0.23 – 2.27	2.25	0.80 – 6.31	0.85
Plant Protein (g)	1.44	0.45 – 4.54	3.23	1.20 – 8.69**	0.80
Fiber (g)	0.48	0.15 – 1.48	2.73	0.98 – 7.60**	0.60
Folate (mcg)	0.58	0.18 – 1.84	1.36	0.49 – 3.77	0.02
Potassium (mg)	2.01	0.62 – 6.51	4.47	1.60 – 12.44**	0.07
Vit A (mcg)	2.52	0.73 – 8.71	2.24	0.86 – 5.84*	0.85

OR: Odds Ratio; **P* <0.10, ***P*<0.05; [a]Adjusted for household size; planned or unplanned pregnancy; parity; marital status; have a driver's license or not. Four nutrients under the odds of eating higher amounts were coded as– 0: less than highest tertile; 1: intake in the highest tertile; Seven nutrients under the odds of eating lower amount were coded as– 0: intake in the highest tertile; 1: intake less than highest tertile. For the outcome variable of ethnicity, the reference category was non-Hispanic Whites.

Intake by Food Groups

The average daily serving intakes for 13 food groups are presented in Table 4. Overall, the lowest average daily intakes were seen for the following recommended food groups: citrus fruit, dark-green vegetables, whole grains and plant protein (Table 4).

Table 4. Descriptive characteristics of food group intakes (n=148)

	Recommended Intake[a]	Mean	SD	Median	Min	Max
Juice		5.7 fl. oz.	8.4	3.1	0.0	54.0
Total Fruit	≥1.5 c.	0.7 c.	0.9	0.5	0.0	4.2
Total Vegetables	≥2.5 c.	1.4 c.	1.0	1.2	0.0	6.7
Dark-green Vegetables		0.2 c.	0.4	0.0	0.0	3.0
Total Grains	≥5 oz.	3.1 c.	1.2	3.0	0.6	7.7
Whole Grains		0.7 c.	1.0	0.1	0.0	6.2
Refined Grains		2.4 c.	1.2	2.3	0.0	7.0
Total Animal Protein	≥5 oz.[b]	6.6 oz.	3.7	6.2	0.8	27.9
Plant Protein	≥5 oz.[b]	0.2 oz.	0.6	0.0	0.0	4.9
Dairy and Dairy Products	≥3 c.	1.7 c.	1.4	1.4	0.0	7.7
Desserts and Sweets		1.8 svgs.	2.0	1.8	0.0	15.2
Fats and Oils	5 tsp.	2.8 tsp.	2.3	2.3	0.0	14.8
Sugar-sweetened Beverages		10.5 fl. oz.	10.5	8.0	0.0	43.0

[a]Recommended intake represents minimum number of servings per day based on ChooseMyPlate.gov, [b]Recommended intake for total protein is ≥5 oz. per day from animal and/or plant sources. *Note: c.=cups, fl. oz.= fluid ounces, oz.= ounces, svgs.= servings, tsp.=teaspoons.*

Of the 13 food groups analyzed, 7 were significantly different by race/ethnicity (results not shown). Ultimately, after controlling for significant socio-demographics, race/ethnic differences were found for 5 food groups. In comparison, African Americans had approximately three times greater odds of falling in the highest tertile of intake for meat and animal protein than non-Hispanic Whites (Table 5). Whereas for Hispanics, the odds of being in the highest tertile for the daily intake of animal protein were 81% lower in comparison to non-Hispanic Whites (Table 5). Hispanic women also had lower odds of being in the upper tertile for sugar-sweetened beverages than the major group of white pregnant women. Among the recommended food groups, the only significant difference seen by race/ethnicity was for dairy. Intake of dairy products was significantly lower among African Americans, with about five times lower odds of being in the highest tertile for dairy and dairy products intake compared to non-Hispanic Whites (Table 5).

Tabe 5. Role of ethnicity in predicting intake of food groups among WIC pregnant women (n = 148)[c]

Food Group	**Hispanics**		**African Americans**		**Hosmer-Lemeshow Statistic**
	Odds of eating higher amounts (highest tertile)				
	OR	95% CI	OR	95% CI	
Meat[a]	1.26	0.27 – 5.80	3.36	0.99 – 11.40**	0.19
Animal Protein[b]	0.19	0.02 – 1.31*	3.81	1.16 – 12.49**	0.96
Desserts	1.33	0.41 – 4.24	0.53	0.19 – 1.44	0.15
Sugar-Sweetened Beverages	0.28	0.06 – 1.23*	0.77	0.29 – 2.03	0.33
	Odds of eating lower amounts (less than highest tertile)				
	OR	95% CI	OR	95% CI	
Fruits	0.35	0.11 – 1.16	1.14	0.40 – 3.27	0.42
Whole Grain	0.80	0.24 – 2.64	1.79	0.63 – 5.08	0.09
Dairy	0.73	0.24 – 2.21	5.58	1.98 – 15.71**	0.43

OR: Odds Ratio; Food groups represent the number of servings. *P<0.10, **P<0.05, Logistic Regression; [a]Meat refers to beef, pork, chicken and other animal meat and meat substitutes; [b]Animal protein includes eggs, fish and everything from the meat category. [c]Adjusted for household size; planned or unplanned pregnancy; parity; marital status; have a driver's license or not. Four nutrients under the odds of eating higher amounts were coded as– 0: less than highest tertile; 1: intake in the highest tertile; Seven nutrients under the odds of eating lower amount were coded as– 0: intake in the highest tertile; 1: intake less than highest tertile. For the outcome variable of ethnicity, the reference category was non-Hispanic White

DISCUSSION

Overall, our findings demonstrate inadequate micronutrient intake in this diverse sample of low-income pregnant women during their second trimester of pregnancy. On average, women under-consumed several nutrients that are promoted in the dietary guidelines for a healthy pregnancy such as fiber, total folate, iron, and potassium. Conversely, there was a high intake of nutrients and food groups that are generally recommended to be eaten in moderation. For instance, the intake of sodium on average was 264% more than the recommended amount of 1500 mg per day. Participants also consumed high amounts of added sugars, saturated fat, and trans fat.

The inadequate intake of folate and iron among study participants is most alarming as deficiencies of either are associated with negative health outcomes for mother and fetus alike; such as altered infant neurodevelopment, preterm delivery, and infant growth restriction (Lammi-Keefe, Couch, & Philipson, 2008). Additionally, the high mean intake of sodium coupled with a low mean intake of potassium among our study participants, provides evidence for high rates of gestational hypertension seen among minority women. Based on the study results, it is apparent that the dietary patterns of WIC pregnant women, representing low-income and predominantly racial/ethnic minority women, are dominated by refined grain products, meat, juice, desserts, and sugar-sweetened beverages. Results of the study by Gamba, Leung, Guendelman, Lahiff, and Laraia (2016) also found similar patterns. Instead of specifically WIC women, Gamba et al. examined the dietary patterns of low-income pregnant women using the 1999-2008 NHANES data (Gamba et al., 2016). In the study, they found that the majority of the dietary recommendations were not met, and the average alternate-healthy eating index score modified for pregnancy, representing quality of diet in meeting dietary guidelines, was 41.9 in comparison to the maximum score of 80. Similar to our study, Gamba et al. also did not see a significant association between food security status and diet quality in the national sample of low-income pregnant women.

The WIC program provides economic assistance for specific nutrient rich foods, such as plant proteins (legumes, peas, peanut butter), low-fat dairy, whole grain bread and cereal products. However, based on the results of our study, it can be concluded that pregnant women might not be utilizing their WIC benefits fully. In a cross-sectional analysis of the Michigan WIC redemption data, it was found that more than one-third of the enrollees did not fully redeem their benefits (Pooler & Gleason, 2014). Similarly, the Texas State Reports on monthly redemption rates of various food categories indicates that on average only 50 to 60 % of WIC money is redeemed for plant protein and grain products such as whole wheat bread, beans, and peanut butter (Texas Department of State Health Services, 2018). The report on evaluation of the revised WIC benefits indicated that on average only 70% of WIC participants fully redeemed or utilized their benefits, with partial to limited use being highest among African Americans (Gleason & Pooler, 2011). In exploring barriers which prevent full redemption of benefits, participants have reported issues such as taste and cultural preferences, and a lack of cooking knowledge for particular foods. In a qualitative study in examining barriers to WIC use, it was found that inability to understand which brands and package size are allowed and not allowed, including poor grocery store experiences and embarrassment, prevented families from making full use of WIC benefits (Najjar, 2013).

The findings of this study also show significant differences in dietary pattern by race and ethnicity. Overall, DRI recommendations for many nutrients were not met among study participants. But, specifically in comparison by race and ethnicity, food and nutrient intakes of African American women were significantly poor among the three groups. Most notably, compare to non-Hispanic Whites, the African American women in our study were consuming high amounts of fat and sodium, and low amounts of fiber and other micronutrients. Corroborating these results, a recent study of the dietary quality of pregnant mothers (n= 7,511) in the periconceptual period also found similar racial/ethnic disparities where African American women scored lowest in meeting the national dietary recommendations, with specifically high consumption of solids fats from fatty meats and grain-based desserts (Bodnar et al., 2017).

In interpreting our findings, the acknowledgement of cultural and regional influences on dietary patterns and food choices is merited. Food choices and preferences are strongly influenced by geographic location, religion, and culture. This study was conducted in the southeastern U.S., where dietary patterns are significantly influenced by regional core foods (Smith et al., 2006). Analyses of regional food variations indicated that the fried foods and use of fatty meat cuts make a significant part of the southern cuisine in the U.S. A study of dietary patterns of pregnant women (n= 1155) living in the mid-south indicated that African American women were more likely to consume diets that were dominated by processed and southern foods, such as fast foods, eggs, cooked cereals, beef or pork dishes, and fried fish (Völgyi et al., 2013). In planning nutrition interventions for diverse population groups, it is vital to do a thorough investigation of the cultural and regional food choices and preferences.

The WIC program is one of the largest food assistance programs and the most effective program in reaching low-income pregnant women. While WIC services and food benefits have been proven to be beneficial for improving home food availability and access to healthy foods (Andreyeva, Luedicke, Middleton, Long, & Schwartz, 2012; Odoms-Young et al., 2013), further efforts are needed to support behavioral changes at the individual level and improve dietary habits of low-income pregnant women. For instance, improving use of the WIC foods by including provision of recipes and cooking demonstrations can be useful in promoting healthy food choices among WIC women. Especially, culturally appropriate and southern-based beans and lentils recipes, can be effective in increasing its WIC redemption and ultimately higher intake of plant protein and dietary fiber among minority women during pregnancy. Especially, considering family-oriented culture of minority population groups of African-Americans and Hispanics, inclusion of other family members in nutrition education programs, might be effective in behavioral changes in food choices.

There are several limitations to this study. The study was conducted with a convenience sample of WIC pregnant women from one clinic in the southeast region and might limit the external validity. This study is also limited by its small sample size and exploratory design; however, racial/ethnic distribution of our study participants is similar to WIC demographic profile at the state and national level. In the future, a larger, multi-state study is warranted to further understand nutrition risks among minority women during pregnancy. Another potential limitation of the study is that not all the participants completed 2 24-h diet recalls and for many an ideal combination was missing. Notwithstanding the limitation, for the majority (84%) of the participants, two diet recalls were completed, and no significant differences were found between groups. Lastly, 24-h recalls are subject to inaccuracies, typically due to reporting errors that may occur in describing homemade recipes and dishes which were common among Hispanic families. However, the use of the multiple-pass method, and rigorous interviewer training and quality check during data analyses, ensures the accuracy of data and results for diet recalls.

CONCLUSION

Overall, as evidenced by the results of this study, the diet quality of low-income pregnant women and specifically of African American women remains an issue of concern. Our study provides important contextual insight of the specific dietary patterns of an ethnically and racially diverse sample of WIC pregnant women, highlighting the importance of culturally appropriate interventions to institute healthy dietary habits among high-risk groups of minority women. In the future, a prenatal nutrition assessment study with a nationally representative sample of minority women is warranted to understand any nutritional disparities occurring during the critical life stage of pregnancy among this population.

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