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Dietary Quality during Pregnancy Varies by Maternal Characteristics in Project Viva: A US Cohort

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Abstract

Background—Maternal diet may influence outcomes of pregnancy and childhood, but data on correlates of food and nutrient intake during pregnancy are scarce.

Objective—To examine relationships between maternal characteristics and diet quality during the first trimester of pregnancy. Secondarily we examined associations of diet quality with pregnancy outcomes.

Methods—As part of the ongoing US prospective cohort study Project Viva, we studied 1,777 women who completed a food frequency questionnaire during the first trimester of pregnancy. We used linear regression models to examine the relationships of maternal age, prepregnancy body mass index, parity, education, and race/ethnicity with dietary intake during pregnancy. We used the Alternate Healthy Eating Index, slightly modified for pregnancy (AHEI-P), to measure diet

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quality on a 90-point scale with each of the following nine components contributing 10 possible points: vegetables, fruit, ratio of white to red meat, fiber, *trans* fat, ratio of polyunsaturated to saturated fatty acids, and folate, calcium, and iron from foods.

Results—Mean AHEI-P score was 61±10 (minimum 33, maximum 89). After adjusting for all characteristics simultaneously, participants who were older (1.3 points per 5 years, 95% confidence interval [CI] [0.7 to 1.8]) had better AHEI-P scores. Participants who had higher body mass index (−0.9 points per 5 kg/m^2, 95% CI [−1.3 to −0.4]), were less educated (−5.2 points for high school or less vs college graduate, 95% CI [−7.0 to −3.5]), and had more children (−1.5 points per child, 95% CI [−2.2 to −0.8]) had worse AHEI-P scores, but African-American and white participants had similar AHEI-P scores (1.3 points for African American vs white, 95% CI [−0.2 to 2.8]). Using multivariate adjusted models, each five points of first trimester AHEI-P was associated lower screening blood glucose level (β −.64 [95% CI −0.02 to −1.25]). In addition, each five points of second trimester AHEI-P was associated with a slightly lower risk of developing preeclampsia (odds ratio 0.87 [95% CI 0.76 to 1.00]), but we did not observe this association with first trimester AHEI-P (odds ratio 0.96 [95% CI 0.84 to 1.10]).

Conclusions—Pregnant women who were younger, less educated, had more children, and who had higher prepregnancy body mass index had poorer-quality diets. These results could be used to tailor nutrition education messages to pregnant women to avoid long-term sequelae from suboptimal maternal nutrition.

Maternal diet during pregnancy may influence outcomes of pregnancy and childhood, such as length of gestation; fetal growth; birth defects; pre-eclampsia; gestational diabetes; and offspring cognitive development, blood pressure, adiposity, and atopic disease (1–11). Diet in the first trimester may be more important to development and differentiation of various organs, whereas diet later in pregnancy may be important for overall fetal growth as well as brain development (11). Although optimal diet at conception is ideal, later in the first trimester may represent the first opportunity for a woman to assess her diet with a clinician, and women may be more open to dietary change during pregnancy than at other times (12). Dietary quality in the first trimester may also be a harbinger of diet quality throughout the pregnancy (13). Beneficial changes in diet, if continued after pregnancy, may have long-term benefits for women’s health (14,15). Data on determinants of dietary quality during pregnancy are scarce.

A composite quality score of foods and nutrients, based on national recommendations, can be a useful tool for evaluating overall diet quality of pregnant women. One such tool is the Diet Quality Index for Pregnancy developed by the Pregnancy, Infection, and Nutrition study (16). One limitation of the Diet Quality Index for Pregnancy is that the total fat component of the instrument may not adequately reflect the quality of pregnant woman’s diet because it does not differentiate among types of fats.

Another way to assess overall diet quality during pregnancy is through a modification to the Alternate Healthy Eating Index used in adults. The Alternate Healthy Eating Index was modified from the Healthy Eating Index developed by the US Department of Agriculture (17). The Alternate Healthy Eating Index was previously shown to be associated with lower risk of cardiovascular disease (18), type 2 diabetes (19), and lower concentrations of

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biomarkers of inflammation and endothelial dysfunction (20). In this article we use a further modified version the Alternate Healthy Eating Index to incorporate nutrition recommendations for pregnancy. We call our score the Alternate Healthy Eating Index for Pregnancy (AHEI-P).

The primary purpose of this study was to examine the relationship between maternal characteristics and diet quality during the first trimester of pregnancy, as measured by the AHEI-P. Secondarily we examined associations of AHEI-P score during the first and second trimester of pregnancy with pregnancy outcomes.

METHODS

Study Design and Participants

We recruited participants into Project Viva at eight offices of Harvard Vanguard Medical Associates, a large multispecialty urban/suburban group practice in eastern Massachusetts. At the first study visit, which immediately followed the woman's initial clinical prenatal visit, we obtained informed consent, administered a brief interview, and provided a take-home self-administered questionnaire, which included a validated 166-item semi-quantitative food frequency questionnaire (FFQ) assessing the woman's diet during early pregnancy, defined as since her last menstrual period until FFQ completion date (21). At the second study visit, which occurred at 26 to 28 weeks' gestation, we again administered a similar FFQ querying dietary intake during the preceding 3 months.

Exclusion criteria included multiple gestation (eg, twins or triplets), inability to answer questions in English, plans to move out of the area before delivery, and gestational age >22 completed weeks at initial prenatal clinical appointment. Additional details of recruitment and follow-up have been presented elsewhere (22).

We enrolled 2,670 pregnant women (64% of those eligible) between April 22, 1999, and July 31, 2002, of whom 329 subsequently became ineligible because of multiple gestation (n=19), transferring obstetric care to a non-study site (n=115), or because they were no longer pregnant (n=195). Of the 2,341 remaining participants, 195 (8%) withdrew and 18 (<1%) were lost to follow-up, leaving 2,128 who delivered live-born infants. Among 2,128 participants who delivered infants, we included in the primary analysis 1,777 (84%) participants who completed the first trimester FFQ. For the secondary analysis, we included 1,777 participants who completed the first trimester FFQ and 1,666 (78%) participants who completed the second trimester FFQ. Institutional review boards of Harvard Pilgrim Health Care, Brigham and Women's Hospital, and Beth Israel Deaconess Medical Center approved the study protocols.

Measurements of Maternal Characteristics

We obtained data directly from participants and from medical records as detailed previously (22). Briefly, at the first visit in early pregnancy, in addition to diet assessment, we obtained information on maternal age, last menstrual period, race/ethnicity, education, household income, marital status, parity, height, and prepregnancy weight.

Maternal diet assessment was by means of a semiquantiative FFQ, slightly modified for use in pregnancy from the extensively validated Willett FFQ used in the Nurses' Health Study and other large cohort studies (23–25). We previously calibrated this questionnaire during pregnancy by comparing dietary intake values obtained using the FFQ against blood levels of several nutrients (21).

AHEI-P

We used the Alternate Healthy Eating Index (18), slightly modified for pregnancy, to measure diet quality on a 90-point scale with each of the following nine components contributing 10 possible points: vegetables; fruit; ratio of white to red meat; fiber; *trans* fat; ratio of polyunsaturated to saturated fatty acids; and folate, calcium, and iron from foods. We excluded the alcohol component from the original Alternate Healthy Eating Index because alcohol is not recommended during pregnancy. We excluded the nuts and soy protein component because women may avoid nuts during pregnancy out of concern for allergen sensitization and we did not want to use only half of the original Alternate Healthy Eating Index component. Instead we included tofu or soybeans in the vegetable component. We also added three components, not part of the original Alternate Healthy Eating Index, to reflect intake of nutrients particularly important during pregnancy: folate, iron, and calcium. We restricted analyses of these three nutrients to intakes from foods only, not including vitamins or supplements. With these modifications of the Alternate Healthy Eating Index, we came up with the AHEI-P.

For each food item on the FFQ, we specified a common serving size (eg, $^{1}/_{2}$ c broccoli or two slices of bacon) and asked participants how often, on average, they consumed this amount. To calculate servings per day of each food, we assigned a numeric value to each frequency category. We then summed frequencies of each contributing food item to calculate servings per day of the food groups of the AHEI-P (vegetables, fruit, white meat, and red meat). We defined white meat as poultry or fish, whereas beef, pork, or lamb, and processed meats were considered red meat. We used gram sums in calculating the ratio of white to red meat.

To calculate intake nutrient intakes, we used the Harvard nutrient composition database used for the Nurses' Health Study and other large cohort studies (23,24). We multiplied the frequency of use of each food by the known nutrient composition of specified portions. We then summed the nutrients across all foods to obtain a total nutrient intake for each participant. We used the nutrient residual method to energy-adjust micronutrients (25). To be consistent with the original Alternate Healthy Eating Index scoring system, we used nutrient density for *trans* fat (percent of energy).

As shown in Table 1, each component contributed 0 to 10 points to the total score. A score of 10 indicates that the participant met the recommendation fully, whereas a score of 0 represents the least healthful dietary behavior. We scored intermediate intakes proportionately between 0 and 10 by multiplying the number of daily servings consumed by 10, and then dividing by the criterion for a maximum score. For example, for a participant who consumed zero servings of vegetables per day we assigned a score of 0; for one serving per day we assigned a score of 2; for three servings per day we assigned a score of 6; and for

>5 servings of vegetables per day we assigned a score of 10. Or if a participant consumed 10 mg iron per day, we assigned a score of 3.7 (10 mg/day×10/(27 [criterion for maximum score]). We summed all component scores to obtain a total diet quality score ranging from 0 (worst) to 90 (best).

Pregnancy Outcomes

Using clinical blood pressure and urine protein measurements, we defined preeclampsia based on recommendations of the National High Blood Pressure Education Program (26). We categorized a woman as having pre-eclampsia if she did not have chronic hypertension but developed increased blood pressure and proteinuria (dip-stick value of 1+ on two or more occasions or ≥ 2+ once) >4 hours but ≤7 days apart, or if she had chronic hypertension and developed proteinuria after 20 weeks' gestation.

In the study population, women were routinely screened for gestational diabetes at 26 to 28 weeks' gestation with a nonfasting oral glucose challenge test in which venous blood was sampled 1 hour after a 50-g oral glucose load. If the 1-hour glucose result was at least 140 mg/dL (7.7 mmol/L), the participant was referred for a 100-g fasting glucose 3-hour tolerance test. Normal results were blood glucose <95 mg/dL (5.2 mmol/L) at baseline, <180 mg/dL (9.9 mmol/L) at 1 hour, <155 mg/dL (8.5 mmol/L) at 2 hours, and <140 mg/dL (7.7 mmol/L) at 3 hours (27). We categorized participants with a normal screening glucose challenge as having normal glucose tolerance; those who failed the challenge test but had zero or one abnormal result on the fasting glucose tolerance test as having impaired glucose tolerance, and those who had at least two abnormal results as having gestational diabetes.

We computed pregnancy weight gain by subtracting self-reported prepregnancy weight from last clinical pre-natal weight recorded in the medical record. In this analysis, we expressed gestational weight gain in categories based on the 1990 recommendations of the Institute of Medicine (ie, inadequate, adequate, excessive) (11).

For newborns, we calculated birth weight for gestational age *z* scores and categorized them as average for gestational age, small for gestational age (<10th percentile), and large for gestational age (>90th percentile) (28).

Data Analysis

In our primary analysis, we used crude and multivariate adjusted linear regression models to examine the cross-sectional relationship between several maternal characteristics selected a priori, namely age, prepregnancy body mass index (BMI; calculated as kg/m^2), parity, education, and race/ethnicity with AHEI-P score. We first examined age, BMI, and parity as categorical exposures to see whether their associations with AHEI-P were linear. Because the associations appeared linear, we included these characteristics as continuous exposures in the regression models. In multivariate adjusted models, we controlled for all of the maternal characteristics simultaneously. We also examined each of the nine components of the AHEI-P score as separate outcomes (range 0 [worst] to 10 [best] points).

In our secondary analysis, we used multivariate adjusted models to examine associations of AHEI-P score in the first trimester (n=1,777) and second trimester (n=1,666) with pregnancy outcomes. The main exposure was AHEI-P score as a continuous measure in 5-point increments. We used linear regression for the continuous outcome screening blood glucose level and logistic regression for the binary outcome preeclampsia. We used multinomial logistic regression for the three-level outcomes (ie, birth weight for gestational age categories, pregnancy weight gain categories, and glucose status categories). For glucose status, for example, multinomial logistic regression calculates the odds of having either gestational diabetes or impaired glucose tolerance compared with the reference group, normal glucose tolerance. We performed all analyses using SAS version 9.1 (2002–2003, SAS Institute, Cary, NC).

RESULTS

Primary Results: Maternal Characteristics with AHEI-P

Of the 1,777 pregnant women included in this study, 28% classified themselves as belonging to racial/ethnic minorities (Table 2). Reflective of a generally employed and insured managed care population, few participants had less than or equal to a high school education (9%) or had annual household incomes below $40,000 (13%). Mean age at enrollment was 32.4±4.9 years, prepregnancy BMI was 24.6±5.3, gestational age at FFQ completion was 11.7±3.1 weeks, and 49% were nulliparous. Compared with participants in the entire cohort, participants in this analysis had higher educational status (69% in this analysis vs 65% in the entire cohort completed a college degree or more) and comprised more whites (72% in this analysis vs 66% in the entire cohort), but were similar in household income, marital status, nausea status, age, and BMI.

As shown in Table 1, mean AHEI-P score was 61±10 (minimum 33 to maximum 89). Table 2 shows crude and multivariate adjusted correlates of AHEI-P score. After adjustment for all characteristics, participants who were older (1.3 points higher [95% confidence interval [CI] 0.7 to 1.8] per 5 years) had better AHEI-P scores. Participants who had higher prepregnancy BMI (0.9 points lower [95% CI −1.3 to −0.4] per 5 kg/m^2), were less educated (5.2 points lower [95% CI −7.0 to −3.5), for ≤ high school vs college graduate) and had more children (1.5 points lower [95% CI −2.2 to −0.8] per child), had worse AHEI-P scores. Multivariate adjusted results were similar to crude results for all characteristics except race/ ethnicity. Before multivariate adjustment, African-American participants had lower AHEI-P scores than white participants (1.6 points lower [95% CI −3.1 to −0.1] for African-American vs 0.0 for white women), but after multivariate adjustment African-American and white participants had similar AHEI-P scores (1.3 points higher [95% CI −0.2 to 2.8] for African-American vs 0.0 for white women). The difference between the crude and multivariate adjusted results for race/ethnicity resulted mainly from confounding by education and age.

Table 3 shows multivariate adjusted regression estimates (95% CI) for the association of maternal characteristics with each of the nine components of the AHEI-P score. Each component has a possible value of 0 (worst) to 10 (best) points (see Table 1 for distributions). Participants who were leaner, older, more educated, and had fewer children had higher scores for most of the individual components. For example, older participants had better scores for intakes of vegetables, fiber, calcium, and folate and had diets lower in *trans* fat (Table 3). Compared with white women, African-American women had some dietary behaviors appearing more healthful (eg, more fruit, higher ratio of white to red meat, higher ratio of polyunsaturated to saturated fatty acids, and less *trans* fat and some less healthful (Table 3). In addition, participants with “other” race/ethnicity and those who were less educated tended to have lower iron intakes.

Secondary Results: AHEI-P with Selected Pregnancy Outcomes

Among 1,777 participants who competed the first trimester AHEI-P, mean maternal blood glucose level at glycemic screening was 114.0±26.4 mg/dL (6.27±1.45 mmol/ L). About 5% of mothers developed gestational diabetes, 3.4% developed preeclampsia, and 50% experienced excessive pregnancy weight gain. At birth, 5.5% of newborns were small for gestational age and 13.7% were large for gestational age. Table 4 shows the extent to which first and second trimester AHEI-P scores were independently associated with pregnancy outcomes. Adjusted for maternal age, BMI, parity, education, and race/ ethnicity, each 5 points of AHEI-P was associated with lower blood glucose (β −.64 mg/dL [−.35 mmol/L [95% CI −0.02 to −1.25] and β −.83 mg/dL [−.046 mmol/L] [95% CI −0.20 to −1.46] using first and second trimester AHEI-P, respectively). In addition, each 5 points of second trimester AHEI-P was associated with a slightly lower risk of developing preeclampsia (odds ratio [OR] 0.87 [95% CI 0.76 to 1.00]), but we did not observe this association with first trimester AHEI-P (OR 0.96 [95% CI 0.84 to 1.10]). Using the first trimester AHEI-P, we observed a slightly lower risk of small for gestational age (OR 0.92 [95% CI 0.82 to 1.02]) and large for gestational age (OR 0.95 [95% CI 0.89 to 1.02]) vs average for gestational age, but the upper confidence limits exceeded 1.0. AHEI-P score was not associated with pregnancy weight gain.

DISCUSSION

This study shows that diet quality during pregnancy, based on a composite measure of foods and nutrients, varies by maternal characteristics. In our primary analysis, we found that participants who were older, leaner, nulliparous, and more educated had higher AHEI-P scores. After adjusting for sociodemographic characteristics, African American and white participants had similar AHEI-P scores.

It also appears that the AHEI-P is a predictor of at least two pregnancy outcomes, lower screening blood glucose level, and slightly lower risk of developing pre-eclampsia. We did not find an association of AHEI-P with pregnancy weight gain, possibly because the AHEI-P was not developed to capture total energy intake. In addition, we might have had insufficient power to detect an association between AHEI-P and the categorical outcomes glucose status and birth weight for gestational age. Studies of larger sample sizes and different populations might be required to determine whether AHEI-P is associated with categorical outcomes. It is also possible that nutrient status entering pregnancy, as reflected by prepregnancy BMI, is more important than pregnancy diet in the development of glucose status (29).

To aid in the interpretation of our results, we computed an example of the affect of AHEI-P score on blood glucose level. For example, each 10 years of age was associated with 2.6 points better AHEI-P score and each 5 points of AHEI-P was associated with 0.64 mg/dL

(0.035 mmol/L) lower blood glucose. Therefore, a 10-year increase in age would translate into approximately 0.33 mg/dL (0.018 mmol/L) lower blood glucose as a continuous variable from the glycemic screening test, which is a small increment. Although we did not find an association between AHEI-P and the most extreme form of hyperglycemia (gestational diabetes), the Hyperglycemia and Adverse Pregnancy Outcome study (30) found strong continuous associations of maternal glucose levels below those diagnostic of diabetes with increased birth weight and increased cord-blood serum C-peptide levels. Thus our finding with continuous glucose levels, even though of modest magnitude, appears important. A similar effect size is seen per 10 BMI points or per each two prior births; smaller effect sizes with less extreme variation in maternal characteristics may result in very small differences in outcomes.

Consistent with our findings, in at least three studies, higher maternal age was associated with healthful dietary intake patterns during pregnancy (16,31,32). In addition, our findings that nulliparous and better-educated women had better diet quality than primiparous or multiparous and less-educated women were consistent with Bodnar and colleagues (16).

Previously reported associations between race/ethnicity and diet quality during pregnancy have been inconsistent. Among women in the second trimester of pregnancy, Siega-Riz and colleagues (33) found that although African-American women consumed higher total energy and higher absolute values of nutrients, white women consumed more protein, iron, folate, and fiber and had lower fat intakes after energy adjustment. Suitor and colleagues (34) observed no differences in energy-adjusted iron intakes between African-American and white low-income pregnant women, but did not estimate folate, fiber, or fat intakes. We found that African-American participants consumed less calcium than white participants, whereas Bodnar and colleagues (16) found no meaningful ethnic differences in intake of calcium among mostly low-income women who participated in the Pregnancy, Infection, and Nutrition study. Cohen and colleagues (35) examined differences in dietary intake by race using one 24-hour recall at 13 to 21 weeks' gestation among 4,589 pregnant nulliparous women participating in the Calcium for Preeclampsia Prevention trial. Consistent with our findings, Cohen and colleagues (35) found that calcium intake was lower among African-American vs white participants (26% of African Americans vs 48% of whites had intakes greater than or equal to the Recommended Dietary Allowances). African-American women are more likely than white women to be lactose intolerant and thus consume fewer dairy products, which may explain this finding (36). In addition, our result is consistent with findings from a representative sample of adults in the United States. Using data from the 1965 and 1977–1978 Nationwide Food Consumption Surveys and the 1989–1991 Continuing Survey of Food Intake by Individuals (all conducted by the US Department of Agriculture), Popkin and colleagues (37) found that calcium intake was lower among African Americans than whites across socioeconomic groups.

Given the increase in prevalence of overweight and obesity among women of childbearing age, many women are entering pregnancy obese. Higher maternal weight entering pregnancy is associated with a number of adverse pregnancy outcomes including increased rates fetal macrosomia and gestational diabetes. However, to our knowledge, only one study has examined differences in diet quality during pregnancy by BMI or overweight status (38).

Consistent with that study, we found that participants who had higher prepregnancy BMI had poorer overall diet quality. Also consistent with our results, in a nationally representative sample of nonpregnant adults aged 20 to 59 years, Howarth and colleagues (39) found that low fiber density and higher percentage of energy from fat were each associated with having a higher BMI.

This study focused on diet quality during the first trimester of pregnancy. We also examined correlates of second trimester AHEI-P scores and obtained similar results (data not shown). This similarity is not surprising, given that in a previous analysis of Project Viva participants we found that overall means of food and energy-adjusted nutrient intakes from foods did not change appreciably from the first to second trimester (13). Our study had several strengths, including a large sample size and a large set of covariates. Although the relatively high socioeconomic position of our participants probably increased the accuracy with which we were able to measure dietary intake, the results may not generalize to other populations. In addition, the prevalence of prepregnancy obesity in this cohort (14.4% with BMI ≥ 30) was lower than national averages (28.3% of women 20 to 39 years of age in the United States during 1999–2000, when Project Viva began) (40). Thus, this population may have somewhat better nutrition than women elsewhere in the United States. Future studies should capture low-income, more obese, unhealthy populations where the diet quality differences may be more pronounced. Finally, as with all survey data, diet was self-reported and thus may under-or overestimate true intake.

Although we did not calibrate the FFQ used in Project Viva for calcium, iron, and fiber, most items in the Project Viva FFQ are the same as those in the Willett FFQ, which has been validated for these three nutrients (25). In addition, the FFQ has also been found to be relatively reproducible and valid in terms of intake of individual foods (41) and dietary patterns (42). Furthermore, the AHEI as assessed by the FFQ has been shown to predict disease outcomes and biomarkers (18–20).

CONCLUSIONS

Women who were younger, less educated, had more children, and who had higher prepregnancy BMI had poorer quality diets in pregnancy. Clinicians could use these results to tailor nutrition education messages to pregnant women to avoid long-term sequelae from suboptimal maternal nutrition.

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Table 1

Mean first trimester food and nutrient intakes and Alternate Healthy Eating Index for Pregnancy scores for 1,777 women participating in Project Viva

	First Trimester Intake			Score	
Component	**Mean ± SD[a]**	**Criterion for minimum score of 0[b]**	**Criterion for maximum score of 10[b]**	**Mean ± SD**	**Minimum to maximum**
Vegetables (servings/d)	2.9±1.8	0	≥5	5.5±2.6	0.1–10
Fruit (servings/d)	3.0±1.8	0	≥4	6.6±2.8	0–10
Ratio of white to red meat	3.3±4.1	0	≥4	6.3±3.2	0–10
Fiber (g/d)	19.8±5.8	0	≥25	7.6±1.8	2–10
Trans fat (% of energy)	1.0±0.3	≥4	≤0.5	8.7±0.9	5–10
P:S[c]	0.5±0.2	≤0.1	≥1	5.5±1.9	1–10
Calcium (mg/d)	1,113±348	0	≥1,200	8.4±1.7	3–10
Folate (g/d)	365±129	0	≥600	6.0±1.8	2–10
Iron (mg/d)	16.7±5.6	0	≥27	6.0±1.6	2–10
Total score				61±10	33–89

[a]SD=standard deviation.

[b]We scored intermediate intakes proportionately between 0 and 10.

[c]Ratio of polyunsaturated to saturated fatty acids.

Table 2

Crude and multivariate adjusted[a] correlates of first trimester Alternate Healthy Eating Index for Pregnancy (AHEI-P) score for 1,777 women participating in Project Viva

	Subjects		AHEI-P Score by Characteristic	Regression Estimate (95% CI[c]) of AHEI-P Score on Each Characteristic	
Characteristic	**n**	**%**	**Mean ± SD[b]**	**Unadjusted**	**Multivariate adjusted[a]**
Prepregnancy body mass index			61.4±10.3	−1.3 (−1.7, −0.8) per 5 kg/m^2	−0.9 (−1.3, −0.4) per 5 kg/m^2
<25	1,143	64	59.8±9.6		
25–<30	381	21	57.9±10.2		
≥30	249	14			
Age (y)				1.5 (1.0, 2.0) per 5 y	1.3 (0.7, 1.8) per 5 y
<25	131	7	55.6±9.5		
25–<35	1,132	64	60.7±10.1		
≥35	514	29	61.6±10.4		
Parity				−1.5 (−2.1, −0.8) per child	−1.5 (−2.2, −0.8) per child
0	873	49	61.5±10.2		
1	631	36	60.1±10.2		
≥2	273	15	58.6±10.1		
Race/Ethnicity					
Black/African American	219	12	59.4±10.7	−1.6 (−3.1, −0.1)	1.3 (−0.2, 2.8)
Other/more than one race	283	16	59.6±10.7	−1.4 (−2.7, −0.1)	0.1 (−1.2, 1.4)
White	1,275	72	61.0±10.0	0.0[d]	0.0[d]
Highest grade completed					
≤ High school diploma	167	9	55.1±9.8	−7.1 (−8.7, −5.5)	−5.2 (−7.0, −3.5)
Some college/tech school	377	21	57.6±10.0	−4.6 (−5.7, −3.4)	−3.4 (−2.2, −4.6)
College graduate	1,233	69	62.2±9.9	0.0[d]	0.0[d]

[a]Adjusted for all characteristics simultaneously.

[b]SD=standard deviation.

[c]CI=confidence interval.

[d]Reference category.

Table 3

Multivariate adjusted[a] regression estimates (95% confidence intervals [CI]) for each of the nine components of the first trimester Alternate Healthy Eating Index for Pregnancy score, for 1,777 women participating in Project Viva. Each component has a possible value of 0 (worst) to 10 (best) points

Characteristic	**Vegetables**	**Fruit**	**White:red meat**	**Fiber**	**Less *trans* fat**	**P:S**[b]	**Calcium**	**Folate**	**Iron**
					regression estimate (95% CI)				
Prepregnancy body mass index (per 5 kg/m²)	0.01 (−0.10, 0.13)	−0.24 (−0.36, −0.11)	−0.17 (−0.31, −0.03)	−0.08 (−0.16, −0.01)	−0.08 (−0.12, −0.05)	0.02 (−0.07, 0.10)	−0.16 (−0.24, −0.08)	−0.13 (−0.20, −0.05)	−0.05 (−0.13, 0.02)
Age (per 5 y)	0.34 (0.20, 0.48)	0.13 (−0.02, 0.28)	0.03 (−0.15, 0.20)	0.35 (0.26, 0.45)	0.07 (0.02, 0.11)	0.09 (−0.01, 0.19)	0.09 (0.00, 0.18)	0.15 (0.05, 0.24)	0.04 (−0.05, 0.12)
Parity (per child)	−0.07 (−0.25, 0.11)	−0.27 (−0.46, −0.07)	−0.15 (−0.37, 0.07)	−0.23 (−0.35, −0.11)	−0.10 (−0.16, −0.04)	−0.17 (−0.30, −0.04)	−0.18 (−0.29, −0.06)	−0.24 (−0.36, −0.12)	−0.08 (−0.19, 0.03)
Race/ethnicity									
African American	−0.09 (−0.48, 0.30)	0.60 (0.19, 1.01)	0.70 (0.23, 1.17)	0.15 (−0.10, 0.41)	0.21 (0.08, 0.33)	1.02 (0.74, 1.31)	−0.99 (−1.25, −0.74)	−0.18 (−0.44, 0.08)	−0.11 (−0.34, 0.13)
Other	0.20 (−0.14, 0.54)	0.36 (−0.00, 0.72)	−0.03 (−0.44, 0.38)	0.12 (−0.10, 0.34)	0.12 (0.01, 0.23)	0.27 (0.02, 0.51)	−0.52 (−0.74, −0.29)	−0.17 (−0.40, 0.06)	−0.25 (−0.46, −0.05)
White[c]	0	0	0	0	0	0	0	0	0
Education									
≤ High school diploma	−1.11 (−1.57, −0.66)	−0.20 (−0.68, 0.28)	−1.39 (−1.94, −0.84)	−0.80 (−1.10, −0.50)	−0.28 (−0.43, −0.13)	−0.45 (−0.78, −0.12)	−0.21 (−0.50, 0.09)	−0.28 (−0.59, 0.02)	−0.49 (−0.77, −0.21)
Some college	−0.44 (−0.76, −0.12)	−0.15 (−0.49, 0.18)	−0.78 (−1.17, −0.40)	−0.57 (−0.78, −0.36)	−0.19 (−0.29, −0.08)	−0.23 (−0.46, 0.00)	−0.13 (−0.33, 0.08)	−0.50 (−0.71, −0.29)	−0.43 (−0.62, −0.23)
College graduate[c]	0	0	0	0	0	0	0	0	0

[a] Adjusted for all characteristics simultaneously.

[b] Ratio of polyunsaturated to saturated fatty acids.

[c] Reference category.

Table 4

Multivariate adjusted[a] associations (95% confidence interval [CI]) of first and second trimester Alternate Healthy Eating Index for Pregnancy (AHEI-P) score (per 5 points) with pregnancy outcomes, for women participating in Project Viva

Outcome	First trimester AHEI-P score (n=1,777)	Second trimester AHEI-P score (n=1,666)
	odds ratio (95% CI)	
Birth weight for gestational age		
Large for gestational age	0.95 (0.89, 1.02)	0.99 (0.92, 1.07)
Small for gestational age	0.92 (0.82, 1.02)	1.00 (0.90, 1.10)
Average for gestational age[b]	1.00	1.00
Pregnancy weight gain[c]		
Excessive	0.99 (0.94, 1.04)	0.99 (0.94, 1.04)
Inadequate	0.95 (0.88, 1.02)	0.99 (0.92, 1.07)
Adequate[b]	1.00	1.00
Preeclampsia vs normal	0.96 (0.84, 1.10)	0.87 (0.76, 1.00)
Glucose status		
Gestational diabetes	0.97 (0.87, 1.08)	0.98 (0.87, 1.09)
Impaired glucose tolerance	1.00 (0.93, 1.08)	0.96 (0.89, 1.03)
Normal[b]	1.00	1.00
	regression estimate (95% CI)	
Blood glucose (mg/dL)[d]	−0.64 (−1.25, −0.02)	−0.83 (−1.46, −0.20)

[a] Adjusted for maternal age, body mass index, parity, education, and race/ethnicity.

[b] Reference category.

[c] Categories of weight gain based on the 1990 recommendations of the Institute of Medicine (11).

[d] To convert mg/dL glucose to mmol/L, multiply mg/dL by 0.055. To convert mmol/L glucose to mg/dL, multiply mmol/L by 18.0. Glucose of −0.64 mg/dL=−0.035 mmol/L.