The association between periconceptional diet quality and adverse pregnancy outcomes

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Abstract

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Background: Diet quality during the periconceptional period can have consequences on pregnancy outcomes with potential life course implications for the pregnant person and the offspring. The Healthy Eating Index (total score) has been related to risk of adverse pregnancy outcomes. Little research has been done, however, evaluating associations of each component of the score with adverse pregnancy outcomes. Further, potential effect modification of these associations by pre-pregnancy body mass index (BMI) or race/ethnicity has not been examined.

Methods: The study was conducted using information obtained as part of a prospective cohort study - the Nulliparous Pregnancy Outcome Study: Monitoring Mothers to be (NuMoM2b). The NuMoM2b was conducted among participants (n = 6,721) recruited from eight medical centers across the U.S. Exposures were the 2010 Healthy Eating Index component (Adequacy scores: total vegetables, greens and beans, total fruit, whole fruit, whole grains, dairy, total protein foods, seafood and plant protein, fatty acid ratio (poly- and monosaturated fatty acids over saturated fatty acids). Moderation scores: refined grains, sodium, and empty calories (SOFAAS: solid fats, alcohol, and added sugars)) and total scores in the periconceptional period. Adequacy components scores have a higher score with higher intake, while moderation components have a higher score with lower intake. Outcomes were adverse pregnancy outcomes, including hypertensive disorders of pregnancy, gestational diabetes mellitus (GDM), and preterm birth (PTB). Hypertensive disorders of pregnancy were defined according to the American College of Obstetricians and Gynecologists. GDM was defined using White's classification. PTB was defined as birth before 37 completed weeks of gestation. Multivariable Poisson regression models were used to estimate adjusted relative risks and corresponding 95% confidence intervals (CIs). The adjustment variables included maternal age, maternal education, maternal race and ethnicity, pre-pregnancy BMI, tobacco use, total energy intake (kcals), and each component score that was not the exposure. Effect modification by race/ethnicity (non-Hispanic White, non-Hispanic Black, Hispanic, Asian, and Other) and pre-pregnancy BMI (normal, obese, overweight) were assessed using models with interaction terms and stratified multivariable Poisson regression models, as described above.

Results: Participant were on average 27.7 years old and 66.2% non-Hispanic White. With each increase in HEI score quartile, participants were more educated (82.3% college educated or more) and had a higher total household income (66.4% with 75k+). In fully adjusted models, the risk of GDM was higher with each unit increase of total protein component score (aRR:1.29, 95% CI: 1.08-1.53) and each unit increase of the dairy component score (aRR: 1.06, 95% CI: 1.01-1.13). The risk of GDM was lower with each unit increase of SOFAAS component score (aRR: 0.960, 95% CI: 0.923-0.998). We also found a higher refined grains component score was associated with a lower risk of gestational hypertension (aRR: 0.95, 95% CI: 0.902-0.997). The risk of PTB was lower with each unit increase of total vegetable (aRR: 0.90, 95% CI: 0.814-0.996) and greens and beans (aRR: 0.89, 95% CI: 0.84-0.95) component scores. We did not find any significant association between chronic hypertension or preeclampsia-eclampsia and the HEI scores. Among non-Hispanic White participants, we found a 10% lower risk of gestational hypertension with each unit increase of seafood and plant protein score (aRR: 0.90, 95% CI: 0.82-0.99). Among Asian participants, we found the risk of gestational hypertension was higher with each unit increase of whole fruit (aRR: 4.31, 95% CI: 1.25-14.89) and fatty acid ratio (aRR: 1.89, 95% CI: 1.29-2.79) scores. Among participants of Other race/ethnicity, the risk of GDM was higher with each unit increase of greens and beans component score (aRR: 3.76, 95% CI: 1.42-9.93). We did not find similar associations among any of the other race/ethnicity strata (confidence intervals crossing one). The risk of gestational hypertension was higher by 23% with each unit increase of whole fruits among participants with obesity (aRR:1.23, 95% CI: 1.03-1.46) but not among normal or participants with overweight (aRR: 1.03, 95% CI: 0.90-1.19 and aRR: 0.99, 95% CI: 0.83-1.18, respectively, p-value for interaction < 0.05). Lastly, there was a potential trending, but not statistically significant, association of PTB with total protein component score among participants with obesity (aRR: 1.23, 95% CI: 0.96-1.58).

Conclusions: We found that higher total protein and dairy scores were associated with higher risk of GDM, while a higher SOFAAS score was associated with a lower risk of GDM. We also found a higher refined grains score was associated with a lower risk of gestational hypertension, and higher total vegetable and greens and beans scores were associated with a lower risk of PTB.

Race/ethnicity and pre-pregnancy BMI modified seafood and plant protein-gestational hypertension and whole fruit-gestational hypertension associations, respectively.

Keywords: periconceptional health, diet quality, healthy eating index, adverse pregnancy outcomes, pregnancy

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Introduction

Poor diet quality is associated with chronic diseases including cardiovascular diseases, diabetes, or cancer. In the United States, almost half of all adults have one or more chronic diseases associated with a poor quality diet.[1] Women's diet during the periconceptional period, defined as the time before and after conception, has implications on occurrence of adverse pregnancy outcomes (APOs).[2,3] In January 2021, the American Heart Association and the National Institutes of Health included APOs in their report on Heart Disease and Stroke Statistics for the first time, estimating that 10-20% of pregnancies are affected by APOs.[3] APOs include hypertensive disorders of pregnancy (HDP; chronic hypertension, gestational hypertension, preeclampsia, and eclampsia), gestational diabetes mellitus (GDM), and preterm birth (PTB). APOs have significant life-course implications for both the parent and offspring. Having any such APOs puts the pregnant person at further risk of being diagnosed with these disorders in a subsequent pregnancy.[3] Additionally, the offspring are at a higher risk for small for gestational age, childhood obesity, and/or cognitive impairments.[4] Lastly, these outcomes are associated with a higher risk of cardiovascular and cardiometabolic diseases later in life for both the parent and offspring.[2,5]

The Healthy Eating Index (HEI) of the USDA Food and Nutrition Service, calculated from food frequency questionnaires or diet recalls, is a measure of diet quality, independent of quantity, that assesses compliance with the U.S Dietary Guidelines for Americans. The HEI-2010 total score (ranging between 0 and 100) is calculated based on 12 components. Higher HEI score indicates better diet quality; a score greater than 80 indicates a "good" diet, scores between 51-80 needs improvement, and a score less than 51 is a "poor" diet.[6] . The U.S Department of Agriculture reports that the average HEI score for women in the United States in 2010 was 59.5

out of 100 – suggesting that most women do not meet the Dietary Guidelines for Americans.[7] Findings from a study conducted using the Nulliparous Pregnancy Outcomes Study: Monitoring Mothers-to-Be (nuMoM2b) cohort participants showed inverse associations of HEI-2010 total score in the periconceptional period with HDP, postpartum hemorrhage, and PTB.[8] Past research, including this study, focused on the total HEI score and not individual components[8], which limits better understanding of potentially complex relationships between diet and APOs.

Further, there are stark racial and ethnic differences in HDP, GDM, and PTB, with people of color being at higher risk of experiencing these outcomes compared to non-Hispanic White people.[5] There are also well described disparities in diet quality amongst racial and ethnic groups.[9] For instance, in the NuMoM2b cohort, participants who identified as non-Hispanic White had the highest mean total HEI score and highest mean scores for 9 of 12 HEI-2010 components, compared to non-Hispanic Black and Hispanic participants.[10] Despite this, no study, has previously examined the role of race and ethnicity in the association between HEI component scores and APOs. There are also no studies investigating the social, structural, and economic reasons why the relationship between the component scores and APOs could differ amongst race and ethnicity. Lastly, despite strong evidence demonstrating associations of pre-pregnancy body mass index (BMI) with both APOs (positive association) and diet quality scores (inverse), limited research investigated the role of pre-pregnancy BMI in the association between HEI components and adverse pregnancy outcomes.[2, 11] The aims of this study were to investigate associations of the 12 individual components of the HEI-2010 with HDP, GDM, and PTB among the NuMoM2b cohort. We also examined the role of race/ethnicity and pre-pregnancy BMI as effect modifiers of the associations of HEI component scores with HDP, GDM, and PTB.

Methods

Study Setting and Study Population

We used a prospective cohort study design and data from the nuMoM2b cohort to investigate periconceptional diet quality and APOs. Participants (N=10,038) in the nuMoM2b were recruited from eight medical centers in the United States from 2010-2013: Case Western University, Columbia University, Indiana University, University of Pittsburgh, Northwestern University, University of California - Irvine, University of Pennsylvania, and University of Utah. Eligible participants were nulliparous birthing people with singleton pregnancies who planned to deliver at one of the medical centers (listed above), had a viable single gestation, were between six weeks and zero days and 13 weeks and six days gestation (from ultrasound), and had no prior pregnancy lasting 20 weeks or longer (self-reported). Exclusion criteria included ages less than 13 years old, a history of three or more spontaneous abortions, current pregnancy complications caused by fatal fetal malformation, known fetal aneuploidy, received a donor oocyte, multifetal reduction, plan to terminate the pregnancy, or participation in an intervention study that may influence maternal or fetal outcomes.[12] Participants (N=9,289) agreed to release their data into shared databases managed by the National Institutes of Health. Criteria for participant selection in the current analysis additionally included completion of the food frequency questionnaire, a reported total energy intake in kcals between 500-3500kcals[13], documented pre-pregnancy BMI within 15-60 kg/m^2,[14] a gestational age of 20 weeks or higher with a live birth outcome (i.e., no stillbirths, terminations, or missing birth status), and maternal age 18 years old or older. The University of Washington Institutional Review Board (IRB) determined the current study did not involve human subjects and did not require exempt status or IRB review.

Data Collection

Participants were interviewed at three study visits before the delivery. Study visit one occurred at six weeks and zero days to 13 weeks and six days; study visit two occurred at 16 weeks and zero days to 21 weeks and six days; study visit three occurred at 22 and zero days weeks to 29 weeks and six days; and, study visit four occurred at delivery or within four weeks postpartum. The exposures and all adjustment covariates used in this analysis were from the first study visit. The outcomes were collected within 30 days of delivery by trained medical chart abstractors.

Exposure and Outcome Variables

The primary exposures were periconceptional HEI-2010 component and total scores calculated from responses to a self-administered Modified 2005 Block Food Frequency Questionnaire at the first study visit. The participants were asked about dietary intake for the three months prior to conception. The HEI score is a total of the components and ranges from 0-100, where a higher score indicates a better alignment with the 2010 dietary guidelines. The components include nine adequacy components: 1) total vegetables, 2) greens and beans, 3) total fruit, 4) whole fruit, 5) whole grains, 6) dairy, 7) total protein foods, 8) seafood and plant protein, 9) fatty acid ratio (poly- and monosaturated fatty acids over saturated fatty acids (PUFAS + MUFAS /SFAs), and three moderation components: 10) refined grains, 11) sodium, and 12) empty calories (SOFAAS: solid fats, alcohol, and added sugars). Adequacy components scores have a higher score with higher intake, while moderation components have a higher score with lower intake. Each component was evaluated as a continuous variable. The standards for HEI-

2010 components are described on the NIH NCI's Developing the Healthy Eating Index website.[15]

The APOs assessed were chronic hypertension, gestational hypertension, preeclampsia-eclampsia, gestational diabetes mellitus, and preterm birth. Diagnostic criteria for these APOs, similar to past research, was as follows[12]: Chronic hypertension diagnosis criteria included 1) a diagnosis of hypertension before pregnancy or 2) hypertension (blood pressure of at least systolic greater or equal to 140 mmHg OR diastolic greater or equal to 90 mmHg on two occasions at least 6 hours apart, or on one occasion followed by antihypertensive medication therapy) before pregnancy or 20 weeks gestation. Gestational hypertension was defined as hypertension at or after 20 weeks gestation with no proteinuria, excluding blood pressures recorded during labor. Preeclampsia was defined as the new onset of hypertension, and at least one of the following criteria: proteinuria (greater than or equal to 300 mg/24hr), Thrombocytopenia (platelet count <100,000/mm^3), or pulmonary edema, at or after 20 weeks gestation. A person with preeclampsia who experienced new-onset seizures was considered to have eclampsia. Gestational diabetes was diagnosed if the pregnant person's glucose tolerance test (GTT) result was one of the following: (1) fasting 3-hour 100-gram GTT with two of the following values: fasting ≥ 95 mg/dL, 1-hour ≥ 180 mg/dL, 2-hour ≥ 155 mg/dL, 3-hour ≥ 140 mg/dL; (2) fasting 2-hour 75-gram GTT with one of the following values: fasting ≥ 92 mg/dL, 1-hour ≥ 180 mg/dL, 2-hour ≥ 153 mg/ dL; (3) non fasting 50-gram GTT with a 1-hour value ≥ 200 mg/ dL if no fasting 3-hour or 2-hour GTT had been performed. PTB was defined as delivery of a liveborn baby between 20 weeks and zero days and 36 weeks and 6 days gestation. All outcomes were categorized as binary variables (having the condition vs. not having the condition).

Other Covariates

Additional covariates considered in the current analyses included maternal race and ethnicity, maternal pre-pregnancy BMI, maternal age, maternal education, total energy intake (kcals), tobacco use, and each component score that was not the exposure. Race and ethnicity were defined as non-Hispanic White, non-Hispanic Black, Hispanic, American Indian, Asian, Native Hawaiian, Other, and Multiracial. Pre-pregnancy BMI was calculated as a continuous variable with height at visit one and self-reported pre-pregnancy weight [(kg)/(m)^2]. Maternal age was the age in years at visit one. Maternal education was categorized as less than high school with no diploma, high school graduate or GED completed, some college credit but no degree, associate or technical degree, Bachelor's degree, Master's degree, and Doctorate or professional degree. Total energy intake in kilocalories was considered as a continuous variable. Tobacco use was categorized as never used tobacco, previous tobacco use, and used tobacco within one month of visit one.

Statistical Analyses

A descriptive analysis was completed to compare sociodemographic characteristics and health behaviors of study participants overall and amongst the HEI-2010 total score quartiles. Multivariable Poisson regression analyses with robust standard errors were used to calculate unadjusted and adjusted relative risks relating each component score and the total score with each individual outcome (i.e., Chronic Hypertension, Gestational Hypertension, Preeclampsia-Eclampsia, GDM, and PTB). Three models were fit: unadjusted, partially adjusted (controlling for maternal age, maternal education, and maternal race and ethnicity) and fully adjusted/primary models (including adjustment variables in the partially adjusted model along with pre-pregnancy

BMI, tobacco use, total energy intake (kcals), and each component score that was not the exposure). For models with the total HEI score as the exposure, component scores were not adjusted for since they comprise the total score. Component scores greens and beans, whole fruits, and seafood and plant protein were not included as covariates in the full models since the food groups used to calculate them are included in total vegetables, total fruits, and total protein foods, respectively.[16]

Effect modification by race/ethnicity (strata of non-Hispanic White, non-Hispanic Black, Hispanic, Asian, and Other) or pre-pregnancy BMI (strata of normal [18.5-25.0 kg/m^2], overweight [25-30 kg/m^2], and obese [>=30 kg/m^2]) were assessed using models (fully adjusted multivariable Poisson regression models described above) that included multiplicative interaction terms and analyses (fully adjusted models) stratified by levels of the effect modifier. Significance of multiplicative interactions (race/ethnicity or pre-pregnancy BMI) was determined using interaction term *p*-values. Stratified analyses were conducted if interaction term *p*-values were significant ($p<0.05$).

A sensitivity analysis was completed by re-analyzing the full model with total household income as a covariate, by including only participants who had a total household income documented ($n = 5{,}720$). We also assessed the characteristics of the participants who were missing total household income. Another sensitivity analysis was completed by adjusting for all component scores, regardless of overlap between the food groups (i.e., total fruit and whole fruit were both adjusted for). Statistical significance for all models was determined using a *p*-value less than 0.05 cutoff and 95% confidence intervals. Analyses were completed using RStudio.

Results

A total of 6,721 participants were included in the final analyses (Figure 1). The average maternal age was 27.7 (SD: 5.33), and 66.2% of the sample was non-Hispanic White (Table 1). Maternal age was higher with each successively higher HEI score quartile, with women in the highest quartile being the oldest, on average (30.0 years old, SD: 4.34). Similar relationships were observed for maternal education and total household income, with the highest quartile having the highest average total household income (66.4% with 75k+) and greatest proportion of participants with bachelor's degree or higher (82.3%). Maternal BMI was lower with each successively higher HEI score quartile, with the highest quartile having the lowest average BMI (24.1 kg/m^2, SD: 4.82). Infant birth weight also was higher with each successively higher HEI score quartile, with infants of participants in the highest total score quartile having the highest average birth weight (kg) (3.33, SD: 0.54). The prevalence of chronic hypertension, preeclampsia-eclampsia, and indicated PTB were inversely related to the HEI score quartile, with fewer women in the highest HEI score quartile experiencing these APOs.

Unadjusted and partially adjusted models for HEI component scores and GDM can be found in Table 2. In fully adjusted/primary models, the association between the SOFAAS component score and GDM was significant (aRR: 0.96, 95% CI: 0.923-0.998, $p < 0.05$). The association between total protein foods component score and GDM was also significant (aRR: 1.29, 95% CI: 1.08-1.53, $p < 0.05$). Lastly, each unit increase in the dairy component score was associated with a statistically significant higher risk of GDM (aRR: 1.06, 95% CI: 1.01-1.13, $p < 0.05$).

Partially adjusted models investigating chronic hypertension and HEI scores showed that each unit increase in whole grains (aRR: 0.93, 95% CI: 0.86-0.99, $p < 0.05$) score, seafood and plant protein (aRR: 0.85, 95% CI: 0.76-0.94, $p < 0.01$) score, and the total score (aRR: 0.98, 95%

CI: 0.97-0.99, $p < 0.01$) were associated with a 7%, 15%, and 2% reduction, respectively, in the risk of chronic hypertension (Table 3). However, these associations were not statistically significant in fully adjusted/primary models.

The unadjusted and partially adjusted associations between gestational hypertension and HEI component scores can be found in Table 4. After full adjustment, however, only the refined grain component score was significantly associated with gestational hypertension (aRR: 0.95, 95% CI: 0.902-0.997, $p < 0.05$). In the partially adjusted models of preeclampsia-eclampsia, higher total protein foods component score was associated with a higher risk of preeclampsia-eclampsia (Table 5; aRR: 1.11, 95% CI: 1.00-1.22, $p < 0.05$). However, in the fully adjusted/primary models, the associations of dietary components with chronic hypertension or preeclampsia-eclampsia were not statistically significant.

The unadjusted and partially adjusted associations between PTB and HEI component scores can be found in Table 6. The risk of PTB was lower by 10% and 11% with each unit increase of total vegetables (aRR: 0.90, 95% CI: 0.814-0.996, $p < 0.05$) and greens and beans (aRR: 0.89, 95% CI: 0.84-0.95, $p < 0.01$) scores, respectively.

In fully adjusted models, interactions of race/ethnicity with greens and beans, total fruit, and total scores on GDM risk were significant (Table 2; interaction $p < 0.05$). Among participants of Other race/ethnicity, a higher greens and beans score was associated with a higher risk of GDM (aRR: 1.14, 95% CI: 1.04-1.26). We did not find similar associations among any of the other race/ethnicity strata. A trend was seen between a higher total fruit score and a lower risk of gestational diabetes among non-Hispanic White participants (aRR: 0.95, 95% CI: 0.84-1.07), while a trend between a higher total fruit score and a higher risk of gestational diabetes among people of Other race/ethnicity (aRR: 1.37, 95% CI: 0.85-2.21), although these results were not statistically significant.

Similarly, interactions of race/ethnicity with whole fruit, seafood and plant protein, fatty acid ratio, and total HEI scores on risk of gestational hypertension were significant (Table 4; interaction $p < 0.05$). In stratified models, a higher seafood and plant protein score was associated with a lower risk of gestational hypertension among non-Hispanic, White participants only (Table 7; aRR: 0.90, 95% CI: 0.82-0.99, $p < 0.05$). A higher fatty acid ratio score was associated with a higher risk of gestational hypertension among Asian participants only (Table 7; aRR: 1.89, 95% CI: 1.27-2.79, $p < 0.05$). There was also a significant association between each unit increase of the whole fruit score was associated with a higher risk of gestational hypertension among Asian participants only (aRR: 4.31, 95% CI: 1.25-14.89). Table 8 shows the models with significant interaction by race/ethnicity with the units of the exposure rescaled to per 10 units.

When testing for potential effect modification by pre-pregnancy BMI, we found significant interactions between pre-pregnancy BMI and total fruit, whole fruit, SOFAAS, and total scores on gestational hypertension (Table 4; interaction p-values $p < 0.05$). In ppBMI stratified models, associations of each unit of whole fruit scores with gestational hypertension (Table 9; aRR: 1.23, 95% CI: 1.03-1.46, $p < 0.05$) was observed only among participants with obesity, but not participants with normal BMI (aRR: 1.03, 95% CI: 0.90-1.19, $p > 0.05$) or participants with overweight (aRR: 0.99, 95% CI: 0.83-1.18, $p > 0.05$). Additionally, we found significant interactions between pre-pregnancy BMI and total protein, seafood and plant protein, and SOFAAS scores on PTB (Table 6; $p < 0.05$). While stratified models on PTB were not statistically significant, there were potential trends among total protein scores and SOFAAS, with associations of higher risk being strongest in the obese strata.

A sensitivity analysis was conducted to compare if the results changed when all components were adjusted for, compared to only controlling components that do not overlap in food groups (Table 10). The results remained similar between the main and sensitivity analyses. Another separate sensitivity analysis was completed to compare results when people who are missing total household income (n = 1001) were excluded from the fully adjusted models. Descriptive characteristics of participants missing total household income are shown in Table 11. Similar trends in maternal age and education in Table 1 can be seen in Table 11, with older and more educated participants in the higher quartiles for HEI score. When analyzing the fully adjusted model excluding participants who are missing total household income (Table 12), no major changes were seen in findings, compared to the full models reported above.

Discussion

Building on previous research on HEI score and APOs, our study found associations between HEI component scores in the periconceptional period and APOs. More specifically, we found higher total protein and dairy scores were associated with a higher risk of GDM, a higher SOFAAS score was associated with a lower risk of GDM, a higher refined grains score was associated with a lower risk of gestational hypertension, and higher total vegetable and greens and beans scores were associated with a lower risk of PTB. Further, we found higher fatty acid ratio and whole fruit component scores were associated with a higher risk of GDM was observed only among Asian participants. We also found a higher greens and beans score was associated with a higher risk of GDM among participants of Other race/ethnicity only. A higher seafood and plant protein scores was associated with a lower risk of gestational hypertension among non-Hispanic White participants only. Lastly, we observed a higher whole fruit score was associated with a higher risk of gestational hypertension, among participants with obesity only. These results show the complex relationship between diet quality and APOs, and how the risk can vary depending on specific food components as well context related to potential effect modifiers.

A wide body of research has illustrated that periconceptional diet quality is a modifiable factor for improving life course health of pregnant people. Previous research with the NuMoM2b cohort found that the lowest quartile of the HEI-2010 score in the periconceptional period had higher risk of HDP, postpartum hemorrhage, and PTB, compared to participants in the highest quartile, after adjusting for covariates.[8] Studies looking at overall diet quality provide insight into the effects of diet on health, but investigating individual components or food groups allows us to target areas for improvement.

Our study found that higher intake of dairy and total protein scores was associated with a higher risk of GDM. Past research has found a higher risk of GDM with higher consumption of animal protein, including meat, eggs, and dairy.[17] Bao et al. (2013) found when comparing the highest and lowest quintiles of animal protein intake (processed and unprocessed) the risk for GDM was higher by 49% (aRR: 1.49, 95% CI: 1.03-2.17), after adjusting for age, parity, BMI, health behaviors, and other dietary intake (i.e., fiber, fats, etc.). Pathophysiology of GDM suggests that protein intake, specifically by-products of processed meat, may increase β-cell toxicity, with further studies showing that even independent of meat consumption, high protein diets are risk factors for GDM, possibly due to the role of amino acids affecting homeostasis and glucose metabolism.[17,18] Other research has found that unprocessed meats can increase A1C in women, which is associated with a higher risk of diabetes.[19] We also found that each unit increase of SOFAAS score (less intake is a higher score) was associated with lower risk of GDM. Other research has found that higher intake of saturated fats (part of SOFAAS) was associated with a higher risk of insulin resistance putting a person at risk for GDM.[20] Our results support these hypotheses, with higher total protein and total dairy scores being associated with a higher risk of GDM and a higher SOFAAS score associated with lower risk of GDM.

We further found that both total vegetables and greens and beans scores were associated with lower risk of PTB. Previous research has found that diet patterns during pregnancy that are high in fruits and vegetables can reduce the risk of PTB (HR: 0.88, 95% CI: 0.80-0.97), compared to diet patterns low in fruits and vegetables.[21] There is limited research investigating the relationship between pre-pregnancy diet quality and the risk of PTB, with most of the studies being outside of the U.S or fruits and vegetables are combined into one category. One study in Australia found that compared to the lowest tertile, the high tertile of pre-pregnancy vegetable pattern reduced the risk of PTB (aRR: 0.62, 95% CI: 0.39-1.00) after adjusting for lifestyle factor and other pregnancy complications.[22] Vegetables may reduce the risk of PTB through their anti-inflammatory and antioxidant properties, which also reduce the risk of other adverse pregnancy outcomes.[23] Our findings support the hypothesis that pre-pregnancy diets high in vegetables is associated with a lower risk of PTB, but more research is needed in this area to support this hypothesis and to further understand the mechanisms.

Similarly, there is limited research on the effects of refined grains in the periconceptional period of pregnancy on the risk of hypertensive disorders of pregnancy, including gestational hypertension. Our study found that an increase in the refined grains score (less intake is a higher score) was associated with a lower risk of gestational hypertension. Refined grains typically have no fiber, vitamins, or minerals and can increase weight gain and inflammation[24], which may be associated with a higher risk of gestational hypertension. However, previous research has found no association between refined or whole grains and gestational hypertension.[25,26] A meta-analysis looking at whole versus refined grains in the general population found the way refined grains are assessed in food frequency questionnaires makes it difficult to disentangle whether it is the refined grain or the sugar in refined grain products that is associated with higher risk of chronic diseases.[24] This may explain the inconclusive findings around refined grain intake and gestational hypertension. Our results provide evidence that lower intake of periconceptional refined grains is associated with a lower risk of gestational hypertension, but more research is needed to understand mechanisms.

We found in partially adjusted models, but not fully adjusted models, that a higher seafood and plant protein component score is associated with lower risk of GDM, chronic and gestational hypertension. Intake of seafood and plant protein have anti-inflammatory properties that are protective factors against hypertensive disorders of pregnancy and DHA/EPA may improve insulin sensitivity, which may explain our findings in partial models.[18,27] However, after controlling for additional confounders, these results were no longer significant.

Furthermore, our results found a higher seafood and plant protein score was associated with a lower risk of gestational hypertension among non-Hispanic White participants, as well as a higher whole fruit and fatty acid ratio scores was associated with a higher risk of gestational hypertension among Asian participants**.** We also found a higher greens and beans score was associated with a higher risk of GDM among participants of Other race/ethnicity. The cost of seafood and plant protein can be more than other protein sources, especially when purchased fresh, compared to preserved. One review found that non-Hispanic White participants spend greater grocery dollars on food and beverages, compared to non-Hispanic Black and Hispanic participants.[28] The same review found that there are differences among racial/ethnic groups in the quantities of highly processed and pre-packaged foods, with non-White groups purchasing more highly processed foods (high in saturated fats and added sugars), compared to non-Hispanic White participants.[28] Separate from the cost, non-Hispanic White women have been found to consume less mercury containing seafoods, compared to non-White participants, which may explain why seafood was a protective factor against gestational hypertension among non-Hispanic White participants in our study.[29] The types of seafood consumed by women nationally vary depending on geography, which we did not control for in this study, could be another reason for the differences in risk of gestational hypertension among racial and ethnic groups.[28] Access to healthy foods is influenced by the built environment around you, as well as overall neighborhood socioeconomic status (SES). There are racial disparities in access to fruits and vegetables, including greens and beans. One study found that neighborhood-SES was associated with reduced intake of vegetables amongst non-Hispanic Black and participants of Other race/ethnicity, compared to non-Hispanic White participants.[30] It is possible that the way vegetables are prepared (i.e., fried, fats added, etc.) amongst different racial and ethnic groups could offset the benefits of greens and beans, however no study has investigated how greens or vegetables are consumed by racial/ethnic groups. Previous research has found that plant-based diet and seafood can be natural vasodilators and have anti-inflammatory effects, leading to reduced diastolic and systolic blood pressure.[31,32] Non-Hispanic Whites may have better access and resources to obtain these types of foods, compared to people of color due to social and economic disadvantage, like food insecurity, and other structural barriers.[33] However, these were not assessed in this analysis, but future research should expand on the complex relationship between HEI component scores and risk of APOs in racially diverse cohorts.

Lastly, it is well known that people with an overweight or obese BMI have a higher risk of many health outcomes, including APOs.[2] However, multiple studies suggest that whole fruit intake has reverse effects on BMI whether this is through intake of fiber, micronutrients, and reduction in calorie consumption.[34,35] Our study found that among participants with obesity, the risk of gestational hypertension was higher with an increase in whole fruit score. Our descriptive findings found that an overall lower diet quality was common for people with obesity, suggesting that the other foods consumed with whole fruit may be driving this association. A different study found that among people with obesity, the types of whole fruits consumed were commonly ice cream, canned fruit, and smoothies, which may lead to an increase in simple sugars.[36] It is also possible that participants who are living with obesity may have changed their dietary pattern to a more favorable dietary type due to a higher risk of chronic diseases. While we did not investigate the types of foods consumed or changes in dietary patterns in our study, this may explain the differences amongst BMI categories.

This study has a few strengths that deserve mention. The prospective design includes dietary assessments prior to pregnancy complications strengthening assessment of temporality in the relationships. The outcomes were ascertained through medical chart abstraction, instead of self-report, reducing the opportunity for misclassification of the outcomes. Lastly, the original study had a comprehensive data collection, with elements of anthropometrics, chart abstracted medical history, psychosocial, and behavioral data points giving us the ability to control for a variety of confounders. The large and diverse sample allowed for generalizability of findings and assessment of effect modification by race/ethnicity as well as pre-pregnancy BMI.

This study also has a few limitations. First, recall bias while completing the food frequency questionnaire can lead to misclassification. Given the prospective nature of data collection, it is likely to be non-differential. There is a possibility of type-1 error due to multiple testing, therefore these results should be interpreted with caution since a correction wasn't performed. Due to the limited research investigating component scores and APOs, we chose not to correct for multiple testing, but future research should investigate how the findings change with more conservative estimates. Selection bias may occur because we excluded participants who did not complete the food frequency questionnaire, missing birth status or total household income. However, sensitivity analyses confirmed that the results remain similar when people who are missing total household income are excluded. Since the food frequency questionnaire is a proprietary instrument, information needed to score the raw data was unavailable, therefore the provided HEI-2010 was used instead of the HEI-2015. Lastly, this sample comprised of nulliparous women who were recruited from university medical centers, which may limit the generalizability.

In conclusion, this study found associations between periconceptional 2010 HEI component scores and APOs. In addition, we also found that associations could vary among groups defined by race/ethnicity or pre-pregnancy BMI. Study findings have implications for better understanding of the relationships between diet and APOs. Better characterization of dietary components that are associated with risk of APOs could facilitate design and implementation of preventive approaches that target APOs in in clinical and public health settings. Future studies should continue to investigate the mechanisms that account for associations between each HEI component score and APOs.

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Table 1: Descriptive characteristics of pregnant people by periconceptional 2010 Healthy Eating Index Score Quartiles in the NuMoM2b Cohort, 2010-2013 (N = 6721)

	HEI-2010 Quartile 1 (n = 1681)	**HEI-2010 Quartile 2 (n = 1680)**	**HEI-2010 Quartile 3 (n = 1680)**	**HEI-2010 Quartile 4 (n = 1680)**	**Total (n = 6721)**
Maternal Age (years), Mean (SD)	24.7 (5.16)	27.2 (5.22)	29.0 (4.98)	30.0 (4.34)	27.7 (5.33)
Race/ethnicity					
American Indian	2 (0.1%)	0 (0%)	2 (0.1%)	1 (0.1%)	5 (0.1%)
Asian	28 (1.7%)	61 (3.6%)	93 (5.5%)	99 (5.9%)	281 (4.2%)
Hispanic	340 (20.2%)	318 (18.9%)	214 (12.7%)	191 (11.4%)	1063 (15.8%)
Multiracial	85 (5.1%)	47 (2.8%)	57 (3.4%)	53 (3.2%)	242 (3.6%)
Native Hawaiian	8 (0.5%)	7 (0.4%)	4 (0.2%)	7 (0.4%)	26 (0.4%)
Non-Hispanic Black	330 (19.6%)	179 (10.7%)	77 (4.6%)	40 (2.4%)	626 (9.3%)
Non-Hispanic White	883 (52.5%)	1059 (63.0%)	1227 (73.0%)	1278 (76.1%)	4447 (66.2%)
Other	5 (0.3%)	9 (0.5%)	6 (0.4%)	11 (0.7%)	31 (0.5%)
Maternal Education					
Less than High School Degree	191 (11.4%)	74 (4.4%)	23 (1.4%)	7 (0.4%)	295 (4.4%)
High School Graduate or GED	356 (21.2%)	184 (11.0%)	98 (5.8%)	30 (1.8%)	668 (9.9%)
Some college, no degree	490 (29.1%)	384 (22.9%)	221 (13.2%)	153 (9.1%)	1248 (18.6%)
Associate's or technical school	204 (12.1%)	184 (11.0%)	184 (11.0%)	106 (6.3%)	678 (10.1%)
Bachelor's Degree	291 (17.3%)	520 (31.0%)	623 (37.1%)	661 (39.3%)	2095 (31.2%)
Master's Degree	113 (6.7%)	233 (13.9%)	355 (21.1%)	477 (28.4%)	1178 (17.5%)
Doctorate or Professional Degree	36 (2.1%)	101 (6.0%)	176 (10.5%)	246 (14.6%)	559 (8.3%)
Total Household Income[1]					
$0-9,999	151 (9.0%)	71 (4.2%)	28 (1.7%)	16 (1.0%)	266 (4.0%)

$10,000-19,999	150 (8.9%)	103 (6.1%)	50 (3.0%)	52 (3.1%)	355 (5.3%)
$20,000-29,999	148 (8.8%)	116 (6.9%)	68 (4.0%)	61 (3.6%)	393 (5.8%)
$30,000-49,999	208 (12.4%)	180 (10.7%)	174 (10.4%)	109 (6.5%)	671 (10.0%)
$50,000-74,999	179 (10.6%)	270 (16.1%)	259 (15.4%)	241 (14.3%)	949 (14.1%)
$75,000-149,999	285 (17.0%)	444 (26.4%)	577 (34.3%)	636 (37.9%)	1942 (28.9%)
$150,000+	83 (4.9%)	222 (13.2%)	361 (21.5%)	478 (28.5%)	1144 (17.0%)
Pre-pregnancy BMI, mean (SD)	26.5 (7.09)	26.0 (6.33)	25.1 (5.57)	24.1 (4.82)	25.4 (6.08)
Underweight (<18.5 kg/m^2)	84 (5.0%)	64 (3.8%)	57 (3.4%)	63 (3.8%)	268 (4.0%)
Normal (18.5-25.0 kg/m^2)	814 (48.4%)	866 (51.5%)	1000 (59.5%)	1125 (67.0%)	3805 (56.6%)
Overweight (25-30 kg/m^2)	373 (22.2%)	381 (22.7%)	348 (20.7%)	316 (18.8%)	1418 (21.1%)
Obese (>= 30kg/m^2)	410 (24.4%)	369 (22.0%)	275 (16.4%)	176 (10.5%)	1230 (18.3%)
MET-Minutes of Physical Activity, Mean (SD)[2]	399 (755)	540 (802)	726 (890)	933 (935)	650 (872)
Minutes of moderate physical activity, Mean (SD)[2]	61.2 (154)	85.9 (176)	106 (173)	134 (163)	96.9 (169)
150+ minutes of moderate PA[2]	223 (13.3%)	340 (20.2%)	443 (26.4%)	601 (35.8%)	1607 (23.9%)
Tobacco use[3]					
Never smoked	828 (49.3%)	995 (59.2%)	1057 (62.9%)	1060 (63.1%)	3940 (58.6%)
Past Smoker	635 (37.8%)	621 (37.0%)	596 (35.5%)	613 (36.5%)	2465 (36.7%)
Smoked during pregnancy	218 (13.0%)	64 (3.8%)	25 (1.5%)	7 (0.4%)	314 (4.7%)
Gestational Diabetes[4]					
None	1578 (93.9%)	1569 (93.4%)	1592 (94.8%)	1596 (95.0%)	6335 (94.3%)
Pregestational	30 (1.8%)	30 (1.8%)	24 (1.4%)	15 (0.9%)	99 (1.5%)

Gestational	72 (4.3%)	79 (4.7%)	64 (3.8%)	68 (4.0%)	283 (4.2%)
Chronic Hypertension[5]	54 (3.2%)	52 (3.1%)	33 (2.0%)	23 (1.4%)	162 (2.4%)
Hypertensive Disorders[5]					
Gestational Hypertension	95 (5.7%)	93 (5.5%)	112 (6.7%)	74 (4.4%)	374 (5.6%)
Preeclampsia-eclampsia	170 (10.1%)	158 (9.4%)	122 (7.3%)	116 (6.9%)	566 (8.4%)
Intrapartum/postpartum Hypertension	158 (9.4%)	147 (8.8%)	151 (9.0%)	152 (9.0%)	608 (9.0%)
None	1256 (74.7%)	1275 (75.9%)	1295 (77.1%)	1332 (79.3%)	5158 (76.7%)
Preterm Birth[6]					
Indicated Preterm Birth	66 (3.9%)	57 (3.4%)	37 (2.2%)	38 (2.3%)	198 (2.9%)
Spontaneous Preterm Birth	83 (4.9%)	72 (4.3%)	84 (5.0%)	72 (4.3%)	311 (4.6%)
Full term birth	1530 (91.0%)	1550 (92.3%)	1557 (92.7%)	1565 (93.2%)	6202 (92.3%)
Infant Birth weight (kg)[7]	3.24 (0.574)	3.30 (0.565)	3.32 (0.541)	3.33 (0.544)	3.30 (0.557)
Normal	1520 (90.4%)	1548 (92.1%)	1555 (92.6%)	1541 (91.7%)	6164 (91.7%)
Low birthweight	105 (6.2%)	72 (4.3%)	75 (4.5%)	75 (4.5%)	327 (4.9%)
Very low birthweight	22 (1.3%)	23 (1.4%)	12 (0.7%)	15 (0.9%)	72 (1.1%)
Infant Female Sex at Birth[8]	820 (48.8%)	781 (46.5%)	791 (47.1%)	811 (48.3%)	3203 (47.7%)
Gestational Age at Delivery[9]	38.7 (2.11)	38.9 (2.03)	38.9 (1.95)	39.0 (1.82)	38.9 (1.98)

[1]Missing = 1001
[2]Missing = 113
[3]Missing = 2
[4]Missing = 4
[5]Missing = 15
[6]Live birth but unknown PTB or FT status = 7, PTB spontaneous/indicated unknown = 3
[7]Missing = 158
[8]Missing = 145, Ambiguous and don't know = 10
[9]Missing = 7

Table 2: Multivariable analysis of 2010 Healthy Eating Index component scores and Gestational Diabetes

	RR (95% CI)	**Partially aRR (95% CI)**	**Fully aRR (95% CI)**	**ppBMI Interaction significance**	**Race/Ethnicity Interaction significance**
HEI-2010 Total Vegetables	1.0 (0.91-1.10)	0.96 (0.87-1.07)	0.99 (0.86-1.15)	0.76	0.26
HEI-2010 Greens and Beans	1.03 (0.96-1.11)	0.99 (0.91-1.08)	1.01 (0.91-1.11)	0.18	0.049*
HEI-2010 Total Fruit	0.96 (0.89-1.04)	0.96 (0.89-1.05)	1.04 (0.95-1.14)	0.55	0.03*
HEI-2010 Whole Fruit	0.93 (0.86-1.01)	0.92 (0.85-1.00)	0.95 (0.86-1.05)	0.16	0.07
HEI-2010 Whole Grains	0.97 (0.93-1.01)	0.98 (0.93-1.02)	1.00 (0.95-1.06)	0.44	0.12
HEI-2010 Dairy	1.01 (0.96-1.06)	1.04 (0.99-1.09)	1.06 (1.01-1.13)*	0.15	0.97
HEI-2010 Total Protein Foods	1.3 (1.10-1.47)**	1.18 (1.03-1.36)*	1.29 (1.08-1.53)**	0.57	0.34
HEI-2010 Seafood and Plant Protein	0.97 (0.90-1.05)	0.91 (0.83-0.99)*	0.97 (0.88-1.06)	0.20	0.10
HEI-2010 Fatty Acid Ratio	1.00 (0.96-1.04)	0.98 (0.94-1.02)	1.03 (0.98-1.10)	0.97	0.58
HEI-2010 Refined Grains	1.02 (0.97-1.07)	1.01 (0.96-1.06)	0.99 (0.94-1.05)	0.28	0.76
HEI-2010 Sodium	0.98 (0.94-1.03)	0.99 (0.95-1.04)	1.01 (0.95-1.08)	0.44	0.87
HEI-2010 SOFAAS	0.99 (0.96-1.01)	0.97 (0.95-0.99)*	0.960 (0.923-0.998)*	0.56	0.23
HEI-2010 Total Score	1.00 (0.99-1.01)	0.99 (0.98-1.00)	1.00 (0.99-1.01)	0.88	0.049*

ppBMI: pre-pregnancy BMI, HEI: Healthy Eating Index, Fatty acid ratio: poly- and monosaturated fatty acids over saturated fatty acids (PUFAS + MUFAS /SFAs), SOFAAS: solids fats, alcohol, and added sugars, RR: unadjusted Relative Risk, Partially aRR: partially adjusted Relative Risk for maternal age (years), education, and race/ethnicity, Fully aRR: fully adjusted Relative Risk for maternal age (years), maternal education, maternal race/ethnicity, pre-pregnancy BMI (kg/m^2), tobacco use, total caloric intake (kcals), and most other component scores (components are not controlled for in the total score since they are added up to create the score). Interaction was assessed with p-values in the full model.

*p<0.05, **p<0.01, ***p<0.001

Table 3: Multivariable analysis of 2010 Healthy Eating Index component scores and Chronic Hypertension

	RR (95% CI)	**Partially aRR (95% CI)**	**Fully aRR (95% CI)**	**ppBMI Interaction significance**	**Race/Ethnicity Interaction significance**
HEI-2010 Total Vegetables	0.90 (0.80-1.01)	0.93 (0.82-1.07)	0.89 (0.75-1.07)	0.21	0.50
HEI-2010 Greens and Beans	0.96 (0.87-1.04)	0.95 (0.86-1.05)	0.96 (0.85-1.08)	0.34	0.80
HEI-2010 Total Fruit	0.89 (0.80-0.99)*	0.90 (0.81-1.00)	1.03 (0.91-1.17)	0.52	0.63
HEI-2010 Whole Fruit	0.93 (0.84-1.03)	0.98 (0.87-1.10)	1.08 (0.95-1.23)	0.18	0.59
HEI-2010 Whole Grains	0.92 (0.86-0.98)**	0.93 (0.86-0.99)*	0.97 (0.90-1.05)	0.47	0.41
HEI-2010 Dairy	0.98 (0.92-1.04)	1.04 (0.98-1.10)	1.05 (0.98-1.14)	0.34	0.79
HEI-2010 Total Protein Foods	1.17 (0.97-1.40)	1.13 (0.94-1.36)	1.09 (0.90-1.33)	0.87	0.96
HEI-2010 Seafood and Plant Protein	0.84 (0.76-0.92)***	0.85 (0.76-0.94)**	0.94 (0.83-1.06)	0.68	0.31
HEI-2010 Fatty Acid Ratio	0.96 (0.92-1.02)	0.96 (0.91-1.02)	1.05 (0.97-1.13)	0.40	0.48
HEI-2010 Refined Grains	0.98 (0.92-1.05)	0.96 (0.90-1.02)	0.99 (0.91-1.07)	0.76	0.21
HEI-2010 Sodium	0.96 (0.90-1.02)	0.94 (0.89-1.00)	0.93 (0.85-1.02)	0.53	0.37
HEI-2010 SOFAAS	0.95 (0.92-0.98)***	0.96 (0.93-0.99)	0.97 (0.91-1.02)	0.67	0.60
HEI-2010 Total Score	0.98 (0.97-0.99)***	0.98 (0.97-0.99)**	0.99 (0.98-1.01)	0.51	0.59

ppBMI: pre-pregnancy BMI, HEI: Healthy Eating Index, Fatty acid ratio: poly- and monosaturated fatty acids over saturated fatty acids (PUFAS + MUFAS /SFAs), SOFAAS: solids fats, alcohol, and added sugars, RR: unadjusted Relative Risk, Partially aRR: partially adjusted Relative Risk for maternal age (years), education, and race/ethnicity, Fully aRR: fully adjusted Relative Risk for maternal age (years), maternal education, maternal race/ethnicity, pre-pregnancy BMI (kg/m^2), tobacco use, total caloric intake (kcals), and most other component scores (components are not controlled for in the total score since they are added up to create the total score). Interaction was assessed with p-values in the full model.

*p<0.05, **p<0.01, ***p<0.001

Table 4: Multivariable analysis of 2010 Healthy Eating Index component scores and Gestational Hypertension					
	RR (95% CI)	**Partially aRR (95% CI)**	**Fully aRR (95% CI)**	**ppBMI Interaction significance**	**Race/Ethnicity Interaction significance**
HEI-2010 Total Vegetables	1.00 (0.93-1.09)	1.00 (0.91-1.09)	1.04 (0.93-1.16)	0.59	0.42
HEI-2010 Greens and Beans	0.98 (0.92-1.05)	0.98 (0.92-1.05)	1.00 (0.93-1.08)	0.36	0.34
HEI-2010 Total Fruit	0.94 (0.88-1.01)	0.95 (0.89-1.03)	1.00 (0.91-1.09)	0.03*	0.08
HEI-2010 Whole Fruit	1.01 (0.94-1.09)	1.02 (0.94-1.11)	1.07 (0.97-1.17)	0.006**	0.02*
HEI-2010 Whole Grains	1.01 (0.98-1.04)	1.00 (0.97-1.04)	1.03 (0.99-1.07)	0.26	0.10
HEI-2010 Dairy	1.01 (0.97-1.05)	1.01 (0.97-1.05)	1.03 (0.98-1.08)	0.82	0.82
HEI-2010 Total Protein Foods	0.99 (0.89-1.11)	1.00 (0.89-1.13)	1.01 (0.88-1.16)	0.88	0.10
HEI-2010 Seafood and Plant Protein	0.92 (0.86-0.98)*	0.91 (0.84-0.98)*	0.94 (0.87-1.02)	0.30	0.02*
HEI-2010 Fatty Acid Ratio	1.00 (0.96-1.03)	1.00 (0.97-1.04)	1.03 (0.98-1.09)	0.14	0.04*
HEI-2010 Refined Grains	0.96 (0.93-1.00)	0.958 (0.921-0.996)*	0.95 (0.902-0.997)*	0.57	0.09
HEI-2010 Sodium	0.98 (0.94-1.01)	0.98 (0.94-1.02)	1.00 (0.94-1.06)	0.56	1.00
HEI-2010 SOFAAS	0.99 (0.97-1.01)	0.99 (0.7-1.01)	0.98 (0.94-1.01)	0.01*	0.14
HEI-2010 Total Score	0.99 (0.99-1.00)	0.99 (0.98-1.00)	1.00 (0.99-1.01)	0.02*	0.006**

ppBMI: pre-pregnancy BMI, HEI: Healthy Eating Index, Fatty acid ratio: poly- and monosaturated fatty acids over saturated fatty acids (PUFAS + MUFAS /SFAs), SOFAAS: solids fats, alcohol, and added sugars, RR: unadjusted Relative Risk, Partially aRR: partially adjusted Relative Risk for maternal age (years), education, and race/ethnicity, Fully aRR: fully adjusted Relative Risk for maternal age (years), maternal education, maternal race/ethnicity, pre-pregnancy BMI (kg/m^2), tobacco use, total caloric intake (kcals), and most other component scores (components are not controlled for in the total score since they are added up to create the total score). Interaction was assessed with p-values in the full model.

*p<0.05, **p<0.01, ***p<0.001

Table 5: Multivariable analysis of 2010 Healthy Eating Index component scores and Preeclampsia-eclampsia

	RR (95% CI)	Partially aRR (95% CI)	Fully aRR (95% CI)	ppBMI Interaction significance	Race/Ethnicity Interaction significance
HEI-2010 Total Vegetables	0.90 (0.85-0.96)**	0.94 (0.88-1.01)	0.92 (0.84-1.02)	0.06	0.54
HEI-2010 Greens and Beans	0.92 (0.89-0.97)**	0.95 (0.90-1.00)	0.94 (0.89-1.00)	0.48	0.58
HEI-2010 Total Fruit	0.93 (0.88-0.98)*	0.95 (0.90-1.00)	0.96 (0.90-1.03)	0.92	0.96
HEI-2010 Whole Fruit	0.93 (0.89-0.99)*	0.98 (0.92-1.03)	0.99 (0.92-1.06)	0.86	0.83
HEI-2010 Whole Grains	0.95 (0.92-0.98)**	0.97 (0.93-1.00)	0.97 (0.93-1.00)	0.37	0.59
HEI-2010 Dairy	0.98 (0.95-1.01)	1.00 (0.97-1.03)	1.00 (0.96-1.04)	0.93	0.09
HEI-2010 Total Protein Foods	1.09 (0.99-1.2)	1.11 (1.00-1.22)*	1.11 (0.99-1.25)	0.18	0.49
HEI-2010 Seafood and Plant Protein	0.92 (0.87-0.97)**	0.96 (0.90-1.01)	0.98 (0.93-1.05)	0.36	0.98
HEI-2010 Fatty Acid Ratio	0.99 (0.96-1.01)	1.00 (0.97-1.03)	1.00 (0.96-1.04)	0.35	0.15
HEI-2010 Refined Grains	0.97 (0.94-1.00)	0.97 (0.94-1.00)	0.99 (0.95-1.03)	0.59	0.21
HEI-2010 Sodium	1.00 (0.97-1.03)	0.99 (0.96-1.02)	1.01 (0.97-1.06)	0.31	0.95
HEI-2010 SOFAAS	0.98 (0.97-1.00)	1.00 (0.98-1.02)	1.01 (0.99-1.04)	0.19	0.30
HEI-2010 Total Score	0.99 (0.98-0.99)***	0.99 (0.99-1.00)	0.99 (0.99-1.00)	0.25	0.87

ppBMI: pre-pregnancy BMI, HEI: Healthy Eating Index, Fatty acid ratio: poly- and monosaturated fatty acids over saturated fatty acids (PUFAS + MUFAS /SFAs), SOFAAS: solids fats, alcohol, and added sugars, RR: unadjusted Relative Risk, Partially aRR: partially adjusted Relative Risk for maternal age (years), education, and race/ethnicity, Fully aRR: fully adjusted Relative Risk for maternal age (years), maternal education, maternal race/ethnicity, pre-pregnancy BMI (kg/m^2), tobacco use, total caloric intake (kcals), and most other component scores (components are not controlled for in the total score since they are added up to create the total score). Interaction was assessed with p-values in the full model.

*p<0.05, **p<0.01, ***p<0.001

Table 6: Multivariable analysis of 2010 Healthy Eating Index component scores and Preterm Birth					
	RR (95% CI)	**Partially aRR (95% CI)**	**Fully aRR (95% CI)**	**ppBMI Interaction significance**	**Race/Ethnicity Interaction significance**
HEI-2010 Total Vegetables	0.89 (0.83-0.95)***	0.924 (0.855-0.999)*	0.90 (0.814-0.996)*	0.71	0.87
HEI-2010 Greens and Beans	0.90 (0.86-0.94)***	0.92 (0.87-0.97)**	0.89 (0.84-0.95)**	0.40	0.99
HEI-2010 Total Fruit	0.96 (0.90-1.02)	0.99 (0.93-1.05)	1.02 (0.95-1.10)	0.68	0.42
HEI-2010 Whole Fruit	0.97 (0.92-1.03)	1.03 (0.97-1.10)	1.07 (0.99-1.15)	0.82	0.91
HEI-2010 Whole Grains	0.99 (0.96-1.02)	1.01 (0.98-1.05)	1.02 (0.98-1.05)	0.92	0.56
HEI-2010 Dairy	0.98 (0.95-1.01)	1.00 (0.97-1.04)	1.00 (0.96-1.05)	0.52	0.54
HEI-2010 Total Protein Foods	1.03 (0.93-1.14)	1.05 (0.94-1.16)	1.05 (0.93-1.18)	0.03*	0.19
HEI-2010 Seafood and Plant Protein	0.93 (0.88-0.99)*	0.97 (0.91-1.04)	0.99 (0.93-1.06)	0.04*	0.97
HEI-2010 Fatty Acid Ratio	0.99 (0.96-1.02)	1.00 (0.97-1.04)	1.02 (0.98-1.07)	0.71	0.54
HEI-2010 Refined Grains	0.98 (0.95-1.02)	0.98 (0.94-1.01)	0.98 (0.94-1.03)	0.36	0.18
HEI-2010 Sodium	1.01 (0.97-1.04)	0.99 (0.96-1.03)	0.98 (0.94-1.03)	0.31	0.55
HEI-2010 SOFAAS	0.98 (0.96-0.99)*	1.00 (0.98-1.02)	0.99 (0.97-1.02)	0.04*	0.63
HEI-2010 Total Score	0.99 (0.983-0.996)**	1.00 (0.99-1.00)	1.00 (0.99-1.01)	0.20	0.90

ppBMI: pre-pregnancy BMI, HEI: Healthy Eating Index, Fatty acid ratio: poly- and monosaturated fatty acids over saturated fatty acids (PUFAS + MUFAS /SFAs), SOFAAS: solids fats, alcohol, and added sugars, RR: unadjusted Relative Risk, Partially aRR: partially adjusted Relative Risk for maternal age (years), education, and race/ethnicity, Fully aRR: fully adjusted Relative Risk for maternal age (years), maternal education, maternal race/ethnicity, pre-pregnancy BMI (kg/m^2), tobacco use, total caloric intake (kcals), and most other component scores (components are not controlled for in the total score since they are added up to create the total score). Interaction was assessed with p-values in the full model.

*p<0.05, **p<0.01, ***p<0.001

Table 7: Stratified by race/ethnicity fully adjusted multivariable analysis of 2010 Healthy Eating Index component scores and pregnancy outcomes

	Gestational Diabetes					**Gestational Hypertension**				
	N-H White	**N-H Black**	**Hispanic**	**Asian**	**Other**	**N-H White**	**N-H Black**	**Hispanic**	**Asian**	**Other**
HEI-2010 Whole Fruit	.	.	.	.	.	1.01 (0.90-1.13)	1.18 (0.95-1.48)	1.20 (0.89-1.61)	4.31 (1.25-14.89)	0.96 (0.69-1.33)
HEI-2010 Seafood and Plant Protein	.	.	.	.	.	0.90 (0.82-0.99)*	0.98 (0.78-1.22)	1.24 (0.92-1.67)	0.85 (0.46-1.56)	0.80 (0.51-1.25)
HEI-2010 Fatty Acid Ratio	.	.	.	.	.	1.03 (0.97-1.09)	0.92 (0.76-1.12)	1.10 (0.93-1.29)	1.89 (1.29-2.79)**	1.00 (0.77-1.30)
HEI-2010 Greens and Beans	0.97 (0.86-1.11)	1.19 (0.89-1.59)	0.90 (0.73-1.10)	0.78 (0.56-1.09)	3.76 (1.42-9.93)**	.	.	.	.	.
HEI-2010 Total Fruit	0.95 (0.84-1.07)	1.14 (0.81-1.61)	1.20 (0.96-1.50)	1.20 (0.86-1.67)	1.37 (0.85-2.21)	.	.	.	.	.
HEI-2010 Total Score	0.99 (0.97-1.00)	1.03 (0.99-1.06)	1.00 (0.98-1.02)	1.01 (0.98-1.05)	1.01 (0.98-1.04)	0.99 (0.98-1.00)	1.03 (1.00-1.07)	1.01 (0.99-1.04)	1.02 (0.97-1.08)	1.02 (0.95-1.09)

HEI: Healthy Eating Index, SOFAAS: solids fats, alcohol, and added sugars, Fully aRR: fully adjusted Relative Risk for maternal age (years), maternal education, pre-pregnancy BMI (kg/m^2), tobacco use, total caloric intake (kcals), and all other component scores for the component score models only (components are not controlled for in the total score since they are added up to create the total score).

*p<0.05, **p<0.01, ***p<0.001

Table 8: Stratified by race/ethnicity fully adjusted multivariable analysis of 2010 Healthy Eating Index component scores in units of ten and pregnancy outcomes

	Gestational Diabetes					Gestational Hypertension				
	N-H White	N-H Black	Hispanic	Asian	Other	N-H White	N-H Black	Hispanic	Asian	Other
HEI-2010 Whole Fruit	.	.	.	.	.	1.00 (0.99-1.01)	1.02 (0.99-1.04)	1.02 (0.99-1.05)	1.16 (1.02-1.31)	1.00 (0.96-1.03)
HEI-2010 Seafood and Plant Protein	.	.	.	.	.	0.99 (0.98-0.99)*	1.00 (0.98-1.03)	1.02 (0.99-1.05)	0.98 (0.93-1.05)	0.98 (0.93-1.02)
HEI-2010 Fatty Acid Ratio	.	.	.	.	.	1.00 (1.00-1.01)	0.99 (0.97-1.01)	1.01 (0.99-1.03)	1.07 (1.03-1.11)**	1.00 (0.97-1.03)
HEI-2010 Greens and Beans	1.00 (0.98-1.01)	1.02 (0.99-1.05)	0.99 (0.97-1.01)	0.98 (0.94-1.01)	1.14 (1.04-1.26)**		.	.	.	.
HEI-2010 Total Fruit	0.99 (0.98-1.01)	1.01 (0.98-1.05)	1.02 (1.00-1.04)	1.02 (0.99-1.05)	1.03 (0.98-1.08)	.	.	.	.	.
HEI-2010 Total Score	1.00 (1.00-1.00)	1.00 (1.00-1.01)	1.00 (1.00-1.00)	1.00 (1.00-1.01)	1.00 (1.00-1.00)	1.00 (1.00-1.00)	1.00 (1.00-1.01)	1.00 (1.00-1.00)	1.00 (1.00-1.01)	1.00 (1.00-1.01)

HEI: Healthy Eating Index, SOFAAS: solids fats, alcohol, and added sugars, Fully aRR: fully adjusted Relative Risk for maternal age (years), maternal education, pre-pregnancy BMI (kg/m^2), tobacco use, total caloric intake (kcals), and all other component scores for the component score models only (components are not controlled for in the total score since they are added up to create the total score).

*p<0.05, **p<0.01, ***p<0.001

Table 9: Stratified by pre-pregnancy BMI fully adjusted multivariable analysis of 2010 Healthy Eating Index component scores and pregnancy outcomes

	Gestational Hypertension			**Preterm Birth**		
	Normal	**Overweight**	**Obese**	**Normal**	**Overweight**	**Obese**
HEI-2010 Total Fruit	0.98 (0.85-1.12)	0.98 (0.82-1.18)	1.08 (0.93-1.27)	.	.	.
HEI-2010 Whole Fruit	1.03 (0.90-1.19)	0.99 (0.83-1.18)	1.23 (1.03-1.46)*	.	.	.
HEI-2010 Total Protein Foods	.	.	.	0.99 (0.89-1.17)	1.05 (0.79-1.39)	1.23 (0.96-1.58)
HEI-2010 Seafood and Plant Protein	.	.	.	0.95 (0.85-1.05)	1.06 (0.92-1.23)	1.02 (0.91-1.14)
HEI-2010 SOFAAS	0.96 (0.91-1.02)	0.94 (0.87-1.01)	1.01 (0.95-1.08)	0.97 (0.93-1.01)	1.02 (0.97-1.08)	1.03 (0.97-1.08)
HEI-2010 Total Score	0.99 (0.98-1.00)	0.99 (0.97-1.01)	1.01 (1.00-1.03)	.	.	.

HEI: Healthy Eating Index, SOFAAS: solids fats, alcohol, and added sugars, Fully aRR: fully adjusted Relative Risk for maternal age (years), maternal education, maternal race/ethnicity, tobacco use, total caloric intake (kcals), and all other component scores for the component score models only (components are not controlled for in the total score since they are added up to create the total score).

*p<0.05, **p<0.01, ***p<0.001

Table 10: Sensitivity analysis; Multivariable analysis of 2010 Healthy Eating Index component scores and adverse pregnancy outcomes adjusting for all component scores					
	CHTN Fully aRR (95% CI)	**GHTN Fully aRR (95% CI)**	**PE Fully aRR (95% CI)**	**GDM Fully aRR (95% CI)**	**PTB Fully aRR (95% CI)**
HEI-2010 Total Vegetables	0.88 (0.67-1.14)	1.05 (0.91-1.23)	0.97 (0.85-1.11)	1.00 (0.82-1.22)	1.00 (0.87-1.15)
HEI-2010 Greens and Beans	1.01 (0.84-1.21)	0.97 (0.88-1..08)	0.95 (0.88-1.04)	1.03 (0.90-1.17)	0.89 (0.81-.97)**
HEI-2010 Total Fruit	0.95 (0.79-1.13)	0.92 (0.82-1.04)	0.95 (0.86-1.04)	1.13 (1.00-1.28)	0.96 (0.87-1.06)
HEI-2010 Whole Fruit	1.13 (0.94-1.35)	1.14 (1.01-1.29)*	1.03 (0.94-1.13)	0.88 (0.77-1.01)	1.11 (1.00-1.23)
HEI-2010 Whole Grains	0.97 (0.89-1.05)	1.03 (0.99-1.07)	0.97 (0.94-1.01)	1.01 (0.96-1.06)	1.02 (0.98-1.06)
HEI-2010 Dairy	1.06 (0.98-1.14)	1.03 (0.98-1.08)	1.00 (0.96-1.04)	1.07 (1.01-1.13)*	1.00 (0.96-1.05)
HEI-2010 Total Protein Foods	1.14 (0.92-1.42)	1.05 (0.90-1.22)	1.15 (1.01-1.30)*	1.33 (1.11-1.6)**	1.09 (0.95-1.25)
HEI-2010 Seafood and Plant Protein	0.92 (0.81-1.04)	0.93 (0.85-1.01)	0.97 (0.90-1.04)	0.92 (0.84-1.02)	0.98 (0.911-1.05)
HEI-2010 Fatty Acid Ratio	1.05 (0.97-1.14)	1.04 (0.98-1.09)	1.01 (0.97-1.05)	1.04 (0.98-1.11)	1.02 (0.98-1.07)
HEI-2010 Refined Grains	0.99 (0.91-1.08)	0.95 (0.91-1.00)	0.99 (0.95-1.03)	0.99 (0.94-1.05)	0.99 (0.95-1.03)
HEI-2010 Sodium	0.94 (0.86-1.03)	1.01 (0.95-1.07)	1.02 (0.97-1.07)	1.02 (0.95-1.09)	0.99 (0.94-1.04)
HEI-2010 SOFAAS	0.97 (0.92-1.03)	0.98 (0.94-1.02)	1.02 (0.99-1.04)	0.96 (0.93-1.00)	0.99 (0.97-1.02)
HEI-2010 Total Score	0.99 (0.98-1.01)	1.00 (0.99-1.01)	0.99 (0.99-1.00)	1.00 (0.99-1.01)	1.00 (0.99-1.01)

CHTN: Chronic Hypertension, GHTN: Gestational Hypertension, PE: Preeclampsia-eclampsia, GDM: Gestational Diabetes Mellitus, PTB: Preterm Birth HEI: Healthy Eating Index, Fatty acid ratio: poly- and monosaturated fatty acids over saturated fatty acids (PUFAS + MUFAS /SFAs), SOFAAS: solids fats, alcohol, and added sugars, Fully aRR: fully adjusted Relative Risk for maternal age (years), maternal education, maternal race/ethnicity, pre-pregnancy BMI (kg/m^2), tobacco use, total caloric intake (kcals), and all other component scores for the component score models only (components are not controlled for in the total score since they are added up to create the total score).

*p<0.05, **p<0.01, ***p<0.001

Table 11: Descriptive characteristics of pregnant people missing total household income by periconceptional 2010 Healthy Eating Index Total Score Quartiles in the NuMoM2b Cohort, 2010-2013 (N = 1001)

	HEI-2010 Quartile 1 (n = 477)	**HEI-2010 Quartile 2 (n = 274)**	**HEI-2010 Quartile 3 (n = 163)**	**HEI-2010 Quartile 4 (n = 87)**	**Total (n = 1001)**
Maternal Age (years), Mean (SD)	22.2 (3.87)	23.4 (4.76)	24.9 (5.23)	26.8 (5.37)	23.4 (4.72)
Race/ethnicity					
American Indian	0 (0%)	0 (0%)	1 (0.6%)	0 (0%)	1 (0.1%)
Asian	2 (0.4%)	9 (3.3%)	5 (3.1%)	6 (6.9%)	22 (2.2%)
Hispanic	142 (29.8%)	114 (41.6%)	72 (44.2%)	35 (40.2%)	363 (36.3%)
Multiracial	29 (6.1%)	8 (2.9%)	6 (3.7%)	2 (2.3%)	45 (4.5%)
Native Hawaiian	1 (0.2%)	2 (0.7%)	0 (0%)	1 (1.1%)	4 (0.4%)
Non-Hispanic Black	131 (27.5%)	51 (18.6%)	21 (12.9%)	4 (4.6%)	207 (20.7%)
Non-Hispanic White	169 (35.4%)	90 (32.8%)	58 (35.6%)	39 (44.8%)	356 (35.6%)
Other	3 (0.6%)	0 (0%)	0 (0%)	0 (0%)	3 (0.3%)
Maternal Education					
Less than High School Degree	93 (19.5%)	33 (12.0%)	13 (8.0%)	3 (3.4%)	142 (14.2%)
High School Graduate or GED	146 (30.6%)	76 (27.7%)	34 (20.9%)	14 (16.1%)	270 (27.0%)
Some college, no degree	152 (31.9%)	93 (33.9%)	57 (35.0%)	32 (36.8%)	334 (33.4%)
Associate's or technical school	55 (11.5%)	30 (10.9%)	23 (14.1%)	9 (10.3%)	117 (11.7%)
Bachelor's Degree	25 (5.2%)	33 (12.0%)	29 (17.8%)	23 (26.4%)	110 (11.0%)
Master's Degree	4 (0.8%)	6 (2.2%)	7 (4.3%)	3 (3.4%)	20 (2.0%)

Doctorate or Professional Degree	2 (0.4%)	3 (1.1%)	0 (0%)	3 (3.4%)	8 (0.8%)
Pre-pregnancy BMI, mean (SD)	26.8 (7.48)	25.9 (6.02)	26.2 (6.12)	24.6 (5.45)	26.3 (6.75)
Underweight (<18.5 kg/m^2)	27 (5.7%)	11 (4.0%)	5 (3.1%)	4 (4.6%)	47 (4.7%)
Normal (18.5-25.0 kg/m^2)	226 (47.4%)	131 (47.8%)	83 (50.9%)	52 (59.8%)	492 (49.2%)
Overweight (25-30 kg/m^2)	95 (19.9%)	77 (28.1%)	37 (22.7%)	20 (23.0%)	229 (22.9%)
Obese (>= 30kg/m^2)	129 (27.0%)	55 (20.1%)	38 (23.3%)	11 (12.6%)	233 (23.3%)
MET-Minutes of Physical Activity, Mean (SD)[1]	328 (609)	405 (689)	470 (660)	532 (664)	390 (647)
Minutes of moderate physical activity, Mean (SD)[1]	53.9 (128)	59.8 (125)	61.1 (106)	86.5 (131)	59.5 (124)
150+ minutes of moderate PA[1]	58 (12.2%)	42 (15.3%)	24 (14.7%)	21 (24.1%)	145 (14.5%)
Tobacco use					
Never smoked	225 (47.2%)	170 (62.0%)	106 (65.0%)	68 (78.2%)	569 (56.8%)
Past Smoker	175 (36.7%)	87 (31.8%)	51 (31.3%)	18 (20.7%)	331 (33.1%)
Smoked during pregnancy	77 (16.1%)	17 (6.2%)	6 (3.7%)	1 (1.1%)	101 (10.1%)
Gestational Diabetes[2]					
None	449 (94.1%)	257 (93.8%)	151 (92.6%)	82 (94.3%)	939 (93.8%)
Pregestational	14 (2.9%)	4 (1.5%)	5 (3.1%)	2 (2.3%)	25 (2.5%)
Gestational	13 (2.7%)	12 (4.4%)	7 (4.3%)	3 (3.4%)	35 (3.5%)
Chronic Hypertension[3]	17 (3.6%)	8 (2.9%)	4 (2.5%)	1 (1.1%)	30 (3.0%)
Hypertensive Disorders[3]					
Gestational Hypertension	28 (5.9%)	10 (3.6%)	14 (8.6%)	4 (4.6%)	56 (5.6%)

Preeclampsia-eclampsia	47 (9.9%)	37 (13.5%)	14 (8.6%)	7 (8.0%)	105 (10.5%)
Intrapartum/postpartum Hypertension	41 (8.6%)	25 (9.1%)	9 (5.5%)	2 (2.3%)	77 (7.7%)
None	360 (75.5%)	200 (73.0%)	126 (77.3%)	73 (83.9%)	759 (75.8%)
Preterm Birth[4]					
Indicated Preterm Birth	23 (4.8%)	12 (4.4%)	2 (1.2%)	3 (3.4%)	40 (4.0%)
Spontaneous Preterm Birth	29 (6.1%)	18 (6.6%)	15 (9.2%)	7 (8.0%)	69 (6.9%)
Full term birth	424 (88.9%)	244 (89.1%)	145 (89.0%)	76 (87.4%)	889 (88.8%)
Infant Birth weight (kg)[5]	3.17 (0.592)	3.19 (0.607)	3.24 (0.532)	3.20 (0.576)	3.19 (0.585)
Normal	420 (88.1%)	244 (89.1%)	150 (92.0%)	78 (89.7%)	892 (89.1%)
Low birthweight	36 (7.5%)	12 (4.4%)	8 (4.9%)	4 (4.6%)	60 (6.0%)
Very low birthweight	8 (1.7%)	7 (2.6%)	1 (0.6%)	2 (2.3%)	18 (1.8%)
Infant Female Sex At Birth[6]	246 (51.6%)	130 (47.4%)	76 (46.6%)	44 (50.6%)	496 (49.6%)
Gestational Age at Delivery[7]	38.6 (2.30)	38.6 (2.26)	38.7 (1.94)	38.7 (2.05)	38.6 (2.21)

[1]Missing = 19
[2]Missing = 2
[3]Missing = 4
[4]Live birth but unknown PTB or FT status = 1, PTB spontaneous/indicated unknown = 2
[5]Missing = 31
[6]Missing = 31, Ambiguous and don't know = 2
[7]Missing = 1

Table 12: Sensitivity analysis - Multivariable analysis of 2010 Healthy Eating Index component scores and all outcomes in the NuMoM2b cohort excluding people with missing total household income (*n* = 5720)

	Chronic HTN	**GHTN**	**PE**	**GDM**	**PTB**
HEI-2010 Total Vegetables	0.87 (0.71-1.07)	1.04 (0.92-1.18)	0.91 (0.81-1.01)	0.95 (0.82-1.11)	0.91 (0.81-1.02)
HEI-2010 Greens and Beans	0.93 (0.81-1.07)	1.01 (0.92-1.10)	0.95 (0.89-1.02)	0.98 (0.88-1.08)	0.92 (0.86-1.00)
HEI-2010 Total Fruit	0.98 (0.85-1.13)	0.97 (0.88-1.07)	0.98 (0.91-1.05)	1.03 (0.93-1.14)	1.01 (0.93-1.09)
HEI-2010 Whole Fruit	1.06 (0.90-1.24)	1.01 (0.91-1.12)	1.00 (0.92-1.08)	0.92 (0.83-1.03)	1.06 (0.97-1.16)
HEI-2010 Whole Grains	0.95 (0.87-1.03)	1.02 (0.97-1.07)	0.98 (0.94-1.02)	1.00 (0.95-1.05)	1.03 (0.99-1.08)
HEI-2010 Dairy	1.03 (0.94-1.12)	1.03 (0.98-1.09)	0.97 (0.93-1.01)	1.06 (1.00-1.12)	0.99 (0.94-1.04)
HEI-2010 Total Protein Foods	1.11 (0.88-1.41)	0.98 (0.84-1.15)	1.13 (0.99-1.30)	1.27 (1.05-1.54)*	1.02 (0.89-1.18)
HEI-2010 Seafood And Plant Protein	0.95 (0.82-1.09)	0.92 (0.84-1.00)	1.01 (0.94-1.09)	0.96 (0.87-1.07)	1.01 (0.93-1.09)
HEI-2010 Fatty Acid Ratio	1.06 (0.98-1.15)	1.04 (0.98-.1.10)	0.98 (0.94-1.02)	1.03 (0.97-1.10)	1.00 (0.96-1.05)
HEI-2010 Refined Grains	0.99 (0.91-1.09)	0.95 (0.90-1.01)	0.98 (0.93-1.02)	0.98 (0.93-1.04)	0.99 (0.94-1.04)
HEI-2010 Sodium	0.94 (0.85-1.03)	1.00 (0.94-1.06)	1.01 (0.96-1.06)	1.00 (0.93-1.08)	0.98 (0.93-1.03)
HEI-2010 SOFAAS	0.98 (0.92-1.05)	0.98 (0.94-1.02)	1.02 (0.99-1.05)	0.97 (0.93-1.01)	1.00 (0.97-1.03)
HEI-2010 Total Score	0.99 (0.97-1.00)	1.00 (0.99-1.01)	0.99 (0.98-1.00)	1.00 (0.98-1.01)	1.00 (0.99-1.01)

HEI: Healthy Eating Index, Fatty acid ratio: poly- and monosaturated fatty acids over saturated fatty acids (PUFAS + MUFAS /SFAs), SOFAAS: solids fats, alcohol, and added sugars, RR: unadjusted Relative Risk, Partially aRR: partially adjusted Relative Risk for maternal age (years), total household income, maternal education, and maternal race/ethnicity, Fully aRR: fully adjusted Relative Risk for maternal age (years), total household income, maternal education, maternal race/ethnicity, pre-pregnancy BMI (kg/m^2), tobacco use, total caloric intake (kcals), and all other component scores for the component score models only (components are not controlled for in the total score since they are added up to create the total score). Interaction was assessed in the fully adjusted model.

*p<0.05, **p<0.01, ***p<0.001

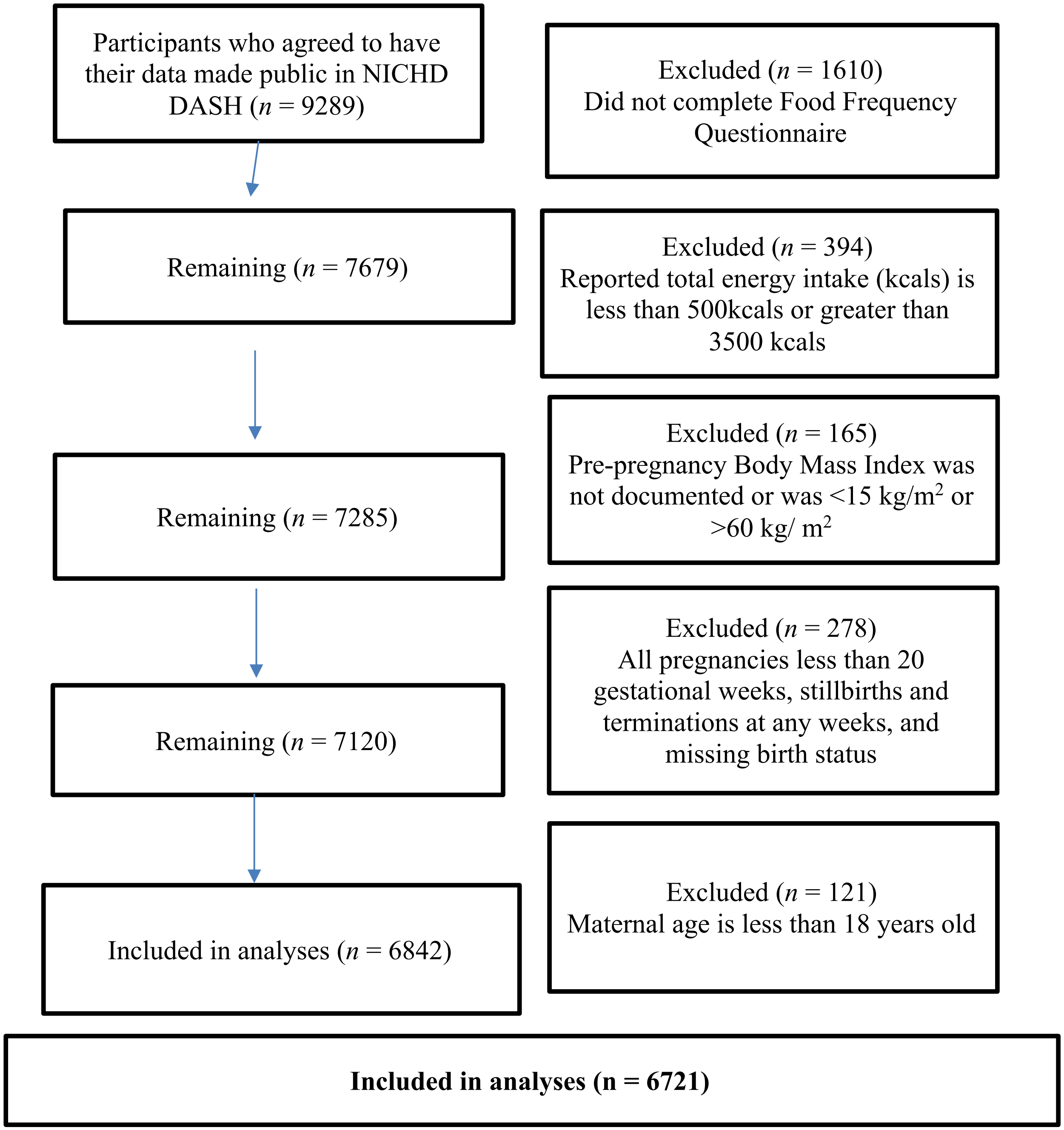

Figure 1: Inclusion criteria for analyses

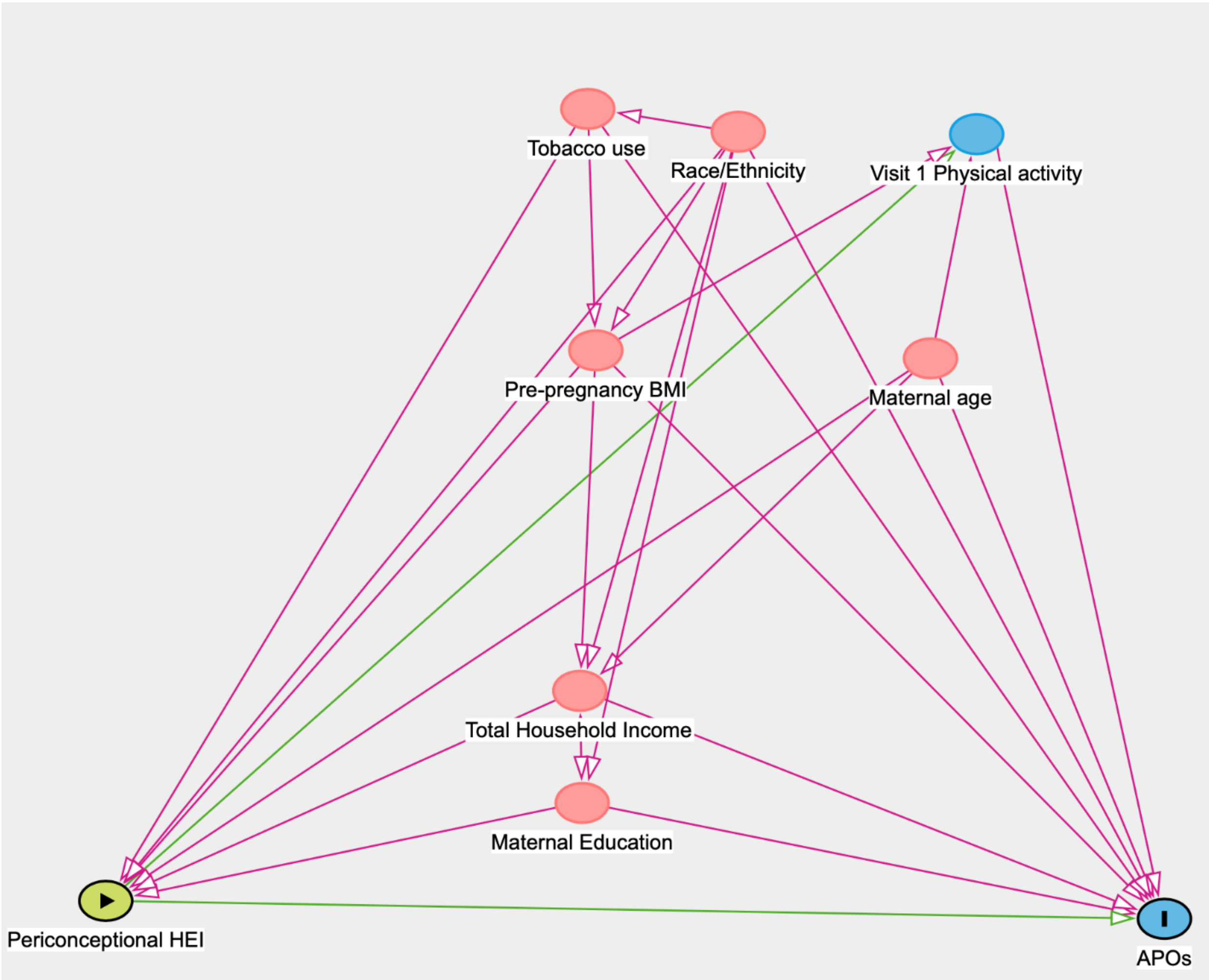

Figure 2: Periconceptional HEI scores and adverse pregnancy outcomes (APOs) DAG