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Vegetarian Diets During Pregnancy: with supplementation, ovo-vegetarian, lacto-vegetarian, vegan, and pescatarian adaptations of USDA Food Patterns can be nutritionally adequate

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Abbreviations: Academy of Nutrition and Dietetics (AND); Acceptable Macronutrient Distribution Range (AMDR); Adequate Intake (AI); Chronic Disease Risk Reduction (CDRR); cup-equivalent (cup-eq); Dietary Guidelines for Americans (DGA); Dietary Guidelines Scientific Advisory Committee Report (DGAC); docosahexaenoic acid (DHA); Dietary Reference Intakes

(DRIs); eicosopentanoic acid (EPA); Food and Nutrition Board (FNB); Healthy Eating Index 2015 (HEI-2015); Healthy Vegetarian Dietary Pattern (HVDP); Institutes of Medicine (IOM); kilocalorie (kcal); multivitamin and mineral (MVM); National Health and Nutrition Examination Survey (NHANES); ounce-equivalent (oz-eq); Recommended Dietary Allowance (RDA); Tolerable Upper Intake Level (UL); World Health Organization (WHO)

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Research Snapshot

Research Question: Can the Dietary Guidelines for Americans (DGA) Healthy Vegetarian Dietary Pattern be adapted for vegan, ovo-vegetarian, lacto-vegetarian, and pescatarian diets during pregnancy using foods and beverages recommended in the DGA?

Key Findings

Across all examined energy levels, vegan, ovo-vegetarian, lacto-vegetarian, and pescatarian adaptations of recommended dietary patterns from the DGA can provide sufficient macronutrients. Without prenatal supplements, these patterns also provided adequate amounts of most, but not all, micronutrients. Diets without meat, eggs, dairy, and/or seafood can be nutritionally adequate for pregnant women, albeit with some micronutrient challenges, like diets that include meat and animal products.

Abstract

Title Vegetarian Diets During Pregnancy: With supplementation, ovo-vegetarian, lacto-vegetarian, vegan, and pescatarian adaptations of USDA Food Patterns can be nutritionally adequate

Background

The 2020-2025 Dietary Guidelines for Americans (DGA) includes a lacto-ovo vegetarian pattern (the Healthy Vegetarian Dietary Pattern; HVDP) as one recommended dietary patterns during pregnancy.

Objective

To adapt the HVDP for vegan, ovo-vegetarian, lacto-vegetarian, and pescatarian diets during pregnancy.

Design

Using food pattern modeling, four adaptations of the HVDP were developed at energy levels that may be appropriate during pregnancy (1800, 2000, 2200, 2400, and 2600 kcal/day). Models were run both with and without the addition of a composite prenatal supplement.

Main Outcome Measures

Main outcome measures were macro- and micronutrient adequacy without exceeding recommendations for saturated fat and added sugar.

Statistical Analysis Performed

The 2020-2025 DGA Food Pattern Modeling Report was used to define food groups and nutrients in the HVDP. The HVDP was revised to remove dairy and/or eggs or to add seafood.

Results

Across all examined energy levels (1800, 2000, 2200, 2400, and 2600 kcal per day), modeled dietary patterns provided sufficient macronutrients. Without prenatal supplements, each dietary pattern met most, but not all, micronutrient recommendations. Micronutrients that were below recommendations in patterns without supplements included vitamin D, iron, vitamin E, sodium, and choline. With the addition of an "composite" prenatal supplement to these patterns, the nutrients below 100% of recommendations were vitamin D, choline, and sodium.

Conclusions

Overall, these results show that a HVDP and similar diets without meat, eggs, dairy, and/or seafood can provide most nutrients needed during pregnancy, albeit with some micronutrient challenges similar to those diets that include meat and other animal products.

Title Vegetarian Diets During Pregnancy: With supplementation, ovo-vegetarian, lacto-vegetarian, vegan, and pescatarian adaptations of USDA Food Patterns can be nutritionally adequate

Introduction

The 2020-2025 Dietary Guidelines for Americans (DGA) includes the first ever federal nutrition guidance for healthy dietary patterns during pregnancy. Its three recommended healthy dietary patterns—a Healthy U.S.-Style Dietary Pattern, Healthy Mediterranean-Style Dietary Pattern, and Healthy Vegetarian Dietary Pattern (HVDP)— can be adapted for pregnancy.[1] Beyond supplement use, there is scant data on the dietary patterns that women follow during pregnancy, including the percentage of women who follow specific vegetarian diets during pregnancy. A recent cross-sectional study estimated that approximately 6% of pregnant women self-identified as vegetarian, with 2% of pregnant women abstaining from some- or all animal-source foods.[2] While the 2020-2025 DGA includes a lacto-ovo HVDP (a vegetarian pattern that includes eggs and dairy foods), which can be followed during pregnancy, the 2020-2025 DGA does not include vegan, ovo-vegetarian, lacto-vegetarian, or pescatarian dietary patterns, nor does it explicitly endorse or discourage following these iterations of vegetarian diets at any point during the lifespan, including during pregnancy.[1] Broadly, vegan dietary patterns include no animal products, ovo-vegetarian dietary patterns do not include meat, poultry, seafood, or dairy (but do include eggs), lacto-vegetarian dietary patterns include dairy but not meat, poultry, seafood, or eggs, and pescatarian dietary patterns do not include meat or poultry but can include dairy, eggs, and seafood.[3]

Veganism is the only one of the vegetarian patterns addressed in this manuscript that is also explicitly mentioned in the 2020-2025 DGA. Each time the word "vegan" is mentioned in the DGA (a total of four instances), it is in reference to potential nutrition challenges during pregnancy. Vitamin B_{12} and iron as well as choline, zinc, iodine, and EPA/DHA are mentioned as specific nutrients of concern for pregnant women following a vegan diet.[1] The American College of Obstetricians and Gynecologists also recommends that individuals following a vegan diet be assessed for nutrient needs during pregnancy, as this dietary pattern "may require vitamin and mineral supplementation."[4]

While the dietary patterns in the DGA that are recommended during pregnancy are the same ones recommended for the rest of the population, the DGA encourages women who are pregnant and need more energy to move to a different energy level of the dietary pattern. For instance, a healthy 25-year-old woman at a healthy pre-pregnancy weight who consumed a 2000 caloric (kcal) diet prior to pregnancy will still need approximately 2000 kcal during the first trimester of pregnancy, ~2400 kcal during the second trimester, and ~2500 kcal during the third trimester.[1] Throughout this manuscript, the terms "woman" or "women" are used to describe people who can become pregnant, because most studies on nutrition and pregnancy to date have been conducted predominantly in populations "assigned female at birth" who also identify as "women." People of all genders can experience pregnancy.[5]

Relative to their nonpregnant and nonlactating peers, women who are pregnant tend to consume healthier eating patterns, as indicated by Healthy Eating Index-2015 (HEI-2015) scores nearly 10 points higher than nonpregnant and nonlactating females in the same age groups.[1] Nonetheless, women who are pregnant still tend to consume fewer servings of vegetables (especially red and orange, beans, peas, and lentils, and starchy vegetables), fruits, and dairy

foods than recommended.[1] Women who are pregnant or lactating also tend to overconsume saturated fat, added sugars, and sodium, similar to the rest of the U.S. population.[1] However, pregnant women are also more likely than their nonpregnant peers to consume multivitamin/-mineral (MVM) supplements, especially supplements that contain folic acid or iron.[6]

Some nutrients, such as folate and iron, are required in higher amounts during pregnancy regardless of dietary patterns.[7,8] The DGA identifies iodine and choline as nutrients of concern for all women during pregnancy in addition to calcium, vitamin D, potassium, and fiber, which are nutrients of public health concern during pregnancy as well as the rest of the lifespan.[1] Prenatal vitamins and supplements often contain folic acid, iron, vitamins A, B_6, D, E, niacin, thiamin, riboflavin, iodine, and zinc.[9-11] Pregnancy is an especially important period for nutrition, as energy and nutrient needs increase, and "consuming a healthy dietary pattern before and during pregnancy may also improve pregnancy outcome" and affect health outcomes for both mother and child in subsequent life stages.[1] Given the recent increase in maternal mortality in the United States from 2019 to 2021, especially among Black women, it is especially important to identify and implement practices that can decrease adverse health outcomes related to pregnancy and childbirth.[12]

Iron is an important nutrient to consider during pregnancy, especially for women who follow vegetarian diets, as the heme iron found in animal source foods is "more readily absorbed by the body than the non-heme iron found in plant source foods (e.g., beans, peas, lentils, and dark green vegetables)."[1] Non-heme iron absorption can be enhanced by consuming sources of non-heme iron (such as fortified cereals, white beans, lentils, and spinach) alongside vitamin C-rich foods.[1] Iodine needs also increase from 150 mcg/day to 220 mcg/day during pregnancy.[13] However, women who do not regularly consume dairy, eggs, seafood, seaweed, or iodized table

salt may have trouble meeting this recommendation. Except for salt and seaweed, these foods are not included in vegan dietary patterns.

The purpose of this study was to ascertain whether the HVDP from the 2020-2025 DGA can be adapted for diets without eggs and/or dairy foods and still remain nutritionally adequate for women during pregnancy. In addition to the vegan, lacto-vegetarian, and ovo-vegetarian adaptations of the HVDP, a pescatarian adaptation of the HVDP was also created to evaluate the nutritional benefits of including seafood in a vegetarian diet during pregnancy using similar food pattern modeling methods as the 2020-2025 Dietary Guidelines Scientific Advisory Committee Report (DGAC).[14]

Materials and Methods

To assess the impact of substitutions within the HVDP to generate vegan, ovo-vegetarian, lacto-vegetarian, and pescatarian dietary patterns, the 2020-2025 DGAC Food Pattern Modeling Report[15] was utilized to develop Excel spreadsheets of the food groups and nutrients in the HVDP, make the changes to the HVDP outlined in the sections below for each adaptation, and evaluate the subsequent nutrient profile of these adaptations by comparing them to Dietary Reference Intakes (DRIs), Acceptable Macronutrient Distribution Ranges (AMDRs), and the original HVDP. DRIs, including Adequate Intake (AI), Recommended Dietary Allowance (RDA), Chronic Disease Risk Reduction (CDRR), were selected to align with DRIs noted in the appendices of the 2020-2025 DGA as goals for women during pregnancy.[1] The amounts of sodium included in each modeled dietary pattern are described in the context of both the AI and the CDRR, since an adequate amount of intake is considered to be at least 1500 mg per day (AI) but not exceeding 2300 mg per day.[16] For those nutrients included in the analysis below but not

included in the 2020-2025 DGA, such as copper and selenium, DRIs reported in the 2020-2025 DGAC Food Pattern Modeling Report were used.[15] The 2020-2025 DGAC Food Pattern Modeling Report[15] utilizes data from the 2015-2016 National Health and Nutrition Examination Survey (NHANES). NHANES survey protocol approvals are conducted by the Research Ethics Review Board at the Centers for Disease Control and Prevention, National Center for Health Statistics.[17]

The HVDP recommends a specific amount of each food group and subgroup be consumed, depending on energy level. A 2000 kcal/day HVDP recommends 2.5 cup-equivalents (cup-eq) of vegetables, 2 cup-eq of fruit, 6.5 ounce-equivalents (oz-eq) of grains, 3 cup-eq of dairy foods, 3.5 oz-eq of protein foods, 27 g of oil, and 250 kcal for other uses.[1] This dietary pattern for the 2020-2025 DGA was created through diet pattern modeling, which uses NHANES data to generate consumption-weighted average nutrient content for each food group and subgroup (fruits, dark green vegetables, etc.) based on the most nutrient-dense foods within that group.[15] For this study, additional models were developed by removing eggs and/or dairy foods or adding seafood to the original HVDP. An overview of the amounts of each food group and subgroup provided in modeled variations of the HVDP can be found in Table 1.

Versions of each of these models were developed both with and without the addition of an "average" prenatal supplement, described in detail below. Because this research was conducted using food pattern modeling of data already in the public domain, Institutional Review Board approval was not required for this work.

Energy levels assessed

The HVDP was adapted at the 1800, 2000, 2200, 2400, and 2600 kcal levels. The DGA provides daily nutritional goals for those who are pregnant by age group and trimester. In this study, models for those who are pregnant at 19-30 and 31-50 years were included. By trimester, for pregnant individuals 19-30 years, 2000 kcal is the estimated daily energy need for the first trimester, 2400 kcal/day for the second trimester, and 2600 kcal/day for the third trimester. For individuals who are pregnant at 31-50 years, 1800 kcal is the estimated daily energy need in the first trimester, 2200 kcal/day in the second, and 2400 kcal/day in the third trimester.[1]

"Composite" Prenatal Supplement Development

While most expecting mothers in the U.S. take a MVM prenatal supplement,[18] there is no standard list of nutrients contained in these products. Yet, because these products are consumed so frequently during pregnancy, it was important to reflect the nutrients provided by prenatal supplements in the models in this study to report versions of each model both with and without a prenatal supplement.

In the absence of data on an "average" prenatal supplement, a composite version of a prenatal supplement was developed comprised of the most frequently included nutrients in prenatal MVM supplements sold at retail. Using the Office of Dietary Supplements' Dietary Supplement Label Database,[9] MVM products on the retail market and labeled for use during pregnancy and lactation were searched. This search yielded 157 supplement labels, which were then organized by vitamin and mineral content. Nutrients with a value greater than zero for the mode, accounting for multiple forms of each nutrient that may be provided in supplements, were identified. For example, both vitamin B_3 and niacinamide as forms of niacin in supplements (Supplemental Table 1) were included. The nutrients included in more than half of the MVMs

187 marketed for use during pregnancy and lactation included: calcium, folic acid, iron, niacin,
188 riboflavin, vitamin A, vitamin B_6, vitamin C, vitamin E, and zinc. Then, because these nutrients
189 were provided in differing amounts in different products, the average amount of each nutrient in
190 these supplements was identified. The final prenatal supplement composite can be found in Table
191 2. For each of the dietary patterns listed below, two HVDP adaptations were created- one that
192 included prenatal supplements and one that excluded them.
193
194 ***Ovo-vegetarian***
195 The ovo-vegetarian model, which contains eggs but not dairy foods, replaced the dairy
196 group with plant-based dairy alternatives recommended as part of the dairy group in the DGA,
197 that is, fortified soy milk and soy yogurt. The dairyALT group, developed in a previous study,[19]
198 replaces the milk, cheese, and yogurt in the original dairy group with soy milk and soy yogurt
199 fortified with calcium, vitamin A, and vitamin D. The dairyALT group is an alternative to the
200 dairy group that reflects only the nutrients from the fortified soy foods included in the "dairy
201 group." In the ovo-vegetarian pattern, the 3 cup-eq of dairy foods were replaced with 3 cup-eq of
202 the dairyALT group.
203
204 ***Vegan***
205 To develop the vegan adaptation of the HVDP, both eggs and dairy foods were replaced.
206 The dairy group in the vegan model was also replaced with the dairyALT group, and servings of
207 eggs were replaced with matching ounce-equivalents of plant-based protein sources (beans, peas,
208 and lentils, soy products, and nuts and seeds). For instance, the 3 oz-eq of eggs in the original

HVDP were replaced with 1 oz-eq of beans, peas, and lentils, 1 oz-eq of soy products, and 1 oz-eq of nuts and seeds.

Lacto-vegetarian

The lacto-vegetarian dietary pattern is similar to the HVDP but does not contain eggs. To compensate for the removal of eggs as a protein food, equivalent amounts of vegetarian protein sources (beans, peas, and lentils, soy products, and nuts and seeds) were increased as detailed above.

Pescatarian

A pescatarian dietary pattern includes eggs and dairy as well as seafood. For the pescatarian model, recommended amounts of seafood from the Healthy U.S.-Style Dietary Pattern were added to each energy level of the HVDP. The Food Pattern Modeling Report from the 2020-2025 DGAC includes both high- and low-omega 3 fish groups.[15] For the purposes of modeling, these two fish groups were combined into a single "seafood" group by weighting the amounts of low- and high-omega 3 fish by consumption (Supplemental Table 3).[15] To mitigate the increase in energy from adding seafood, the amount of refined grains was decreased by 0.5 oz-equivalents (oz-eq) each day in this model, a process that has been utilized in previous modeling studies.[20]

Results

Nutrient adequacy of HVDP adaptations without prenatal supplements

Each HVDP adaptation at every energy level provided amounts of macronutrients within the AMDRs. AMDRs remain the same throughout adulthood, regardless of pregnancy status: carbohydrates as 45-64% of total energy, fat/lipids as 20-35% of total energy, and protein as 10-35% of total energy.[1] Most micronutrients were provided in sufficient amounts; however, vitamin D fell below 65% of the RDA in all models at all energy levels, with the lacto-vegetarian and pescatarian models providing the least vitamin D. Amounts of iron also tended to be below the RDAs for HVDP adaptations without prenatal supplements. All models at all energy levels provided at least 50% of the DRI for iron (RDA), vitamin E (RDA), and choline (AI), but none of the patterns provided enough of any of these nutrients to meet or exceed DRIs. These models did provide adequate α-linoleic acid, with the pescatarian models providing the greatest amounts of EPA and DHA. Results are presented by kcal level and trimester, since nutrient needs change throughout pregnancy. Ovo-vegetarian and vegan patterns at the 2000 kcal level can be found in Table 4 and lacto-vegetarian and pescatarian models at the 2000 kcal level can be found in Table 5. On these tables, percent of energy is reported for fat, carbohydrate, protein, and saturated fat. Results for all other energy levels can be found in Supplemental Tables 6 through 13. Specific tables for each energy level are listed below.

1800 kcal levels – trimester 1, females 31-50 y (Supplemental Tables 6 and 7)

Caloric adequacy was ±10 kcal for the lacto-vegetarian and pescatarian models, but the ovo-vegetarian and vegan models provided an additional 71 and 64 additional kcal, respectively. Zinc was provided in adequate amounts in the pescatarian and lacto-vegetarian models only. Folate, another nutrient of concern in pregnancy, was provided in adequate amounts in the ovo-vegetarian and vegan models and was provided in a range of 96.17-99.67% of the RDA in the

lacto-vegetarian and pescatarian models as well as the original HVDP. All models provided adequate amounts of vitamin B_{12}. Micronutrients that fell below 100% of the DRIs in all models include sodium (50.31-63.21% CDRR and 87.33-96.93% AI), niacin (90.15-99.49% RDA), and vitamin B_6 (88.02-95.91% RDA).

2000 kcal levels – trimester 1, 19-30 y (Tables 4 and 5)

The lacto-vegetarian and pescatarian models provided 2000 ± 9 kcal, while the ovo-vegetarian and vegan models provided additional energy (72 and 65 kcal, respectively). The vegan and ovo-vegetarian models provided a range of 58.59-61.63% of the RDA for vitamin D. Adequate amounts of zinc were provided by the lacto-vegetarian and pescatarian models, but the ovo-vegetarian and vegan models provided approximately 86% of the RDA for zinc. Folate was provided at 99% or higher of the RDA in all four models. The pescatarian model provided the highest amounts of EPA (0.073 g) and DHA (0.165 g). Other nutrients that were provided in less than 100% of the DRIs across all four models included sodium (52.10-64.95% CDRR and 79.87-99.60% AI). All models provided 90% or more of the RDAs for vitamin B_6 and niacin. These models provided adequate amounts of vitamin B_{12} (RDA), calcium (RDA), vitamin C (RDA), and vitamin K (AI).

2200 kcal levels – trimester 2, 31-50 y (Supplemental Tables 8 and 9)

The lacto-vegetarian and pescatarian models provided 2000 ± 9 kcal, while the ovo-vegetarian and vegan models provided 75 and 71 additional kcal, respectively. At least 95% of the RDA for zinc was provided by all four models. Amounts of folate (RDA), calcium (RDA), magnesium (RDA), phosphorus (RDA), potassium (AI), copper (RDA), selenium (RDA),

vitamin A (RDA), thiamin (RDA), riboflavin (RDA), niacin (RDA), vitamin B_6 (RDA), vitamin K (AI), and vitamin B_{12} (RDA) met the DRIs (specific DRI noted next to each nutrient) in all four models. The pescatarian models provided the highest amount of each omega-3 fatty acid (0.082 g and 0.185 g, respectively). Additional nutrients that were provided in amounts less than the recommended intakes include sodium (56.97-70.30% CDRR) and vitamin E (73.33-78.76% RDA) across all models. Sodium was below the AI for the ovo-vegetarian and vegan models (87% of AI) and above the AI for the lacto-vegetarian and pescetarian models (104.46-107.80% of AI).

2400 kcal level – trimester 2, females 19-30 y, trimester 3, females 31-50 y (Supplemental Tables 10 and 11)

Energy in these models was adequate for the lacto-vegetarian diet, while the ovo-vegetarian and vegan models provided 75 additional kcal. The amount of vitamin D in the lacto-vegetarian model fell below 50% of the RDA. At least 50% of the DRIs for all other micronutrients was provided in all four models. The micronutrients with <100% of the DRI provided at the 2400 kcal level included iron (RDA), sodium (CDRR), vitamin E (RDA), vitamin D (RDA), and choline (AI). The ovo-vegetarian, vegan, and pescetarian models provided between 1420 and 1427 mg sodium of the 1500 mg AI, while the lacto-vegetarian model provided 1676 mg sodium.

2600 kcal – trimester 3, females 19-30 y (Supplemental Tables 12 and 13)

Energy in these models was provided in adequate amounts with the vegan and ovo-vegetarian patterns providing ~70 to 80 additional calories. Vitamin D was the only

micronutrient below 50% of the RDA (35.34%) in the lacto-vegetarian pattern alone. The other micronutrients provided at <100% of DRIs included iron (RDA), sodium (CDRR), vitamin E (RDA), and choline (AI). The 2600 kcal models provided above the AI for sodium (103.4-124.6%).

Nutrient adequacy of HVDP adaptations with prenatal supplements

With the addition of a composite prenatal supplement to these dietary patterns (at all energy levels and for all age ranges), the only nutrients below 100% of recommendations- besides vitamin D- were choline and sodium (data not shown). With the supplements, iron amounts in the models also increased from a range of 15 to 25 mg/day to 42-53 mg/day. Therefore, some models exceeded the 45 mg/day Tolerable Upper Intake Level (UL) set for iron during pregnancy. Of the retail available prenatal MVMs that contributed to the average, 117 out of 157 supplements contained at least 27 mg of iron, the RDA for pregnancy. With the prenatal supplement, vitamin B_6 was provided in a range of 9.5 to 10.3 mg/day providing well above 200% of the RDA for vitamin B_6. The pescatarian model at 2600 kcals provided the highest amount of vitamin B_6 (10.3 mg), when both food sources and the prenatal supplement were included.

Discussion

A recent study states that vegetarian and vegan diets can be appropriate across life stages, including pregnancy, as they can "reduce chronic disease risk."[21] However, there are several nutrients of concern that are especially important for women following vegetarian diets to consider during pregnancy and for their healthcare providers to both be aware of and prepared to

provide counsel about. Most of the iterations of the HVDP discussed in this manuscript provide adequate amounts of both macro- and micronutrients, even without the addition of a prenatal supplement. While the amounts of vitamin D (RDA), vitamin E (RDA), and choline (AI) were below the DRIs in these models, they are also below the DRIs in the original dietary patterns in the DGA, including in those patterns containing animal-source foods.

Because this composite calculated prenatal supplement does not include vitamin D, these models remained inadequate in vitamin D even with the supplement. The World Health Organization (WHO), which provides dietary and nutrition guidance for pregnancy, recommends including a prenatal supplement that contains folic acid as well as calcium, iron, vitamin A, vitamin B_{12}, and vitamin D, if these nutrient needs cannot be met through diet alone.[22] Similarly, the DGA recommends a prenatal MVM for pregnant people to obtain adequate amounts of folate/folic acid, iron, iodine, and vitamin D.[23] More specific to individuals who are pregnant and following a vegetarian or vegan diet, the DGA indicates that supplementation may be necessary to obtain adequate iron, vitamin B_{12}, choline, iodine, EPA, and DHA.[1,23] The World Health Organization's (WHO) recommendation on antenatal multiple micronutrient supplements (MMS) include iron and folic acid "in the context of rigorous research."[22] The Academy of Nutrition and Dietetics (AND) reiterates the viewpoint of the Food and Nutrition Board of the National Institute of Science, Engineering and Medicine, which recommends that "women who can become pregnant consume 400 ug/day folic acid from fortified foods or supplements daily."[24]

Iron

Several of these patterns provide insufficient amounts of iron in the absence of prenatal supplements. The 2020-2025 DGAC report also notes that the food patterns in the DGA may not meet iron needs of women during pregnancy.[14] Therefore, because iron is a critically important nutrient in pregnancy, the 2020-2025 DGAC recommends specifically incorporating foods rich in iron- as well as folate, choline, and vitamin D- during pregnancy, including red meat, seafood, eggs, green leafy vegetables, fortified grains, fortified milk, nuts, seeds, and vegetable oils. For women eating different vegetarian diets, many of these food items are not part of their eating patterns. Some iron-rich vegetarian alternatives to these foods include breakfast cereals fortified with iron as well as white beans, lentils, spinach, and tofu.[9]

The composite prenatal MVM supplement calculated for this study includes iron. Yet, while most women do take a prenatal MVM during pregnancy, some of the most nutritionally vulnerable women do not. Data from 1999-2014 NHANES indicate that approximately 64% of pregnant women use prenatal supplements. However, single women, women 20-34 years, women in their first trimester, women from lower-income families, and non-Hispanic Black and Hispanic women were less likely to use prenatal supplements than their counterparts.[6] Data on how many of these women may also be following vegetarian eating patterns are not available. Across the U.S. population, low iron intake is a nutrient of public health concern in women who are pregnant "based on biomarker data that suggests low nutrient status."[14] Therefore, it is especially important for women choosing a vegetarian diet during pregnancy to carefully consider their iron intake and the bioavailability of their dietary iron sources with the guidance of a healthcare professional. Due to the lower bioavailability of iron in dietary patterns that do not contain meat, the iron RDA for vegetarians is 1.8-fold higher than the RDA for people who eat meat.[8] Even without considering vegetarian dietary patterns, the Institute of Medicine (IOM)

368 notes that pregnant women need iron supplementation due to known median intake being well
369 below recommendations.[8] Similarly, the DGA advises pregnant individuals to take an iron
370 supplement when recommended by an obstetrician.

371 Iron is a nutrient of public health concern, and adequate intake becomes more important
372 during pregnancy when iron needs increase due to increases in plasma volume and red cell mass
373 expansion.[8] Consuming adequate iron decreases the risk of maternal and infant mortality,
374 premature birth, and low birthweight.[8] Risks associated with consuming supplemental iron over
375 25 mg include a reduction in zinc absorption as well as gastrointestinal effects such as
376 constipation, a condition that affects approximately 25% of pregnancies.[25]

377

378 *Sodium*

379 Sodium was provided in varying amounts below 2300 mg/day in modeled dietary
380 patterns. The Chronic Disease Risk Reduction Intake (CDRR) of 2300 mg/day for sodium was
381 established to prevent chronic disease associated with high sodium intake.[16] The Adequate Intake
382 (AI) value for sodium, however, is a "recommended average daily nutrient intake level based on
383 observed or experimentally determined approximations or estimates of nutrient by a group (or
384 groups) of apparently health people who are assumed to be maintaining an adequate nutritional
385 state."[16] The AI established for pregnancy across all age groups is the same as the AI for all
386 adults over the age of 19: 1500 mg/day.[16] All models successfully provided less than the 2300
387 mg/day CDRR amount, and most models met the 1500 mg/day AI. Even so, these models are not
388 likely indicative of actual sodium intake amounts of Americans during pregnancy. In one
389 nationally representative study quantifying sodium and potassium intake during pregnancy in
390 relation to blood pressure, 984 normotensive women displayed sodium intake in quartiles

391 defined by Q1 at ≤2581.9 mg/day, Q2 at ≥ 2581.9 mg/day, Q3 at ≥ 3363.54 and < 4337.42
392 mg/day, and Q4 at > 4337.42 mg/day.[26] These amounts exceed the CDRR but better represent
393 actual sodium intake during pregnancy. With the unique physiological needs of pregnancy in
394 relation to sodium intake, some data show that the amount of salty foods consumed during
395 pregnancy increased in 26.1% of the survey sample when compared to pre-pregnancy intake
396 levels.[27]
397
398 *Vitamin B_6*
399 Vitamin B_6 was provided in a range of 1.7 to 2.5 mg/day in models without the addition
400 of prenatal supplements. With the addition of a prenatal supplement, the amount of vitamin B_6 in
401 the pescatarian pattern at the 2600 kcal/level represents 539.89% of the 1.9 mg/day RDA;
402 however, it does not reach the 100 mg/day UL.[28] Due to the maximum amount of vitamin B_6
403 provided by the models including a prenatal vitamin (10.3 mg) not reaching the UL value of 100
404 mg/day, and vitamin B_6's water solubility, consumption of vitamin B_6 in these amounts appears
405 to provide minimal risk of toxicity or harm. Current observational study data indicates no
406 association between vitamin B_6 supplements and teratogenic effects in a mean dose of 132.3±7.4
407 mg/day for 7-9 weeks of gestation.[28] It is also worthwhile noting that by direction of a physician,
408 vitamin B_6 can be used to treat nausea and vomiting in pregnancy in 10-25 mg/day.[28]
409
410 *Vitamin B_{12}*
411 Without the addition of prenatal supplements, these models provided a range of 3.6 to 7.2
412 mcg/day, meeting the RDA met across all models, patterns, and energy levels. The vegan
413 models, across all energy levels, with no sources of animal foods, still provided adequate

amounts of vitamin B_{12}. The sufficiency of vitamin B_{12} in these models, even without supplementation, was due to inclusion of fortified non-dairy milk alternatives such as soymilk in these models.

With the addition of a prenatal supplement, vitamin B_{12} was provided in a range of 22.5 mcg/day to 26.1 mcg/day providing well above 200% of the RDAs set for pregnancy. However, a UL has not been established for vitamin B_{12}, because "even at large doses, vitamin B_{12} is generally considered to be safe because excess vitamin B_{12} is not stored."[29]

Vitamin A

Models provided a range of 807 to 1086 mcg/day of vitamin A from food sources alone. With the addition of a prenatal supplement, these models provided a range of 1815 to 2094 mcg/day. The UL for vitamin A during pregnancy is 3000 mcg/day.[30] While models did not reach the UL, it is important to note that vitamin A is fat-soluble and, therefore, excess amounts of the vitamin can accumulate.[30] Despite vitamin A's importance in fetal growth and tissue maintenance, total intakes of preformed vitamin A that exceed the UL can cause congenital birth defects.[30] It is therefore advised that those who are pregnant or lactating should not take doses higher than 3000 mcg retinal activity equivalents of vitamin A per day.[30] The prenatal supplement composite provided 1008 mcg of vitamin A per day.

Folate/Folic Acid

Models provided a range of 577 to 901 mcg/day of folate/folic acid from food, and the RDA for pregnancy is 600 mcg/day. With the addition of a prenatal supplement, the range of folate/folic acid in models increased to 1732 to 2056 mcg/day. The UL for folic acid, which

applies to synthetic forms of folate found in dietary supplements and fortified foods, is 1000 mcg/day for all adults ages 19+, including those who are pregnant or lactating.[31] The composite prenatal supplement used in this modeling study contained 1155 mcg of folate/folic acid (as listed on labels), an amount that exceeds the UL. Folate, like vitamins B_6 and B_{12}, is water soluble so excess amounts do not accumulate.[31] However, high folate intake can mask vitamin B_{12} deficiency. Both folate and vitamin B_{12} deficiencies can manifest as megaloblastic anemia. Providing folate to correct a vitamin B_{12} deficiency may lead to neurological symptoms. While a deficiency of either of the B vitamins presents in the same manner, a folate deficiency does not present with neurological effects like vitamin B_{12} deficiency.[31]

Vitamin C

Models provided a range of 114 to 164 mg/day of vitamin C without the addition of a prenatal supplement, and a range of 222 mg/day to 272 mg/day with the supplement. Models provided adequate vitamin C (85 mg/day is the RDA for pregnancy)[32] without the addition of the prenatal supplement. However, these amounts did not exceed nor approach the 2000 mg/day UL set for pregnancy, which applies to vitamin C intake from both foods and supplements.[32] According to the NIH Office of Dietary Supplements, vitamin C has "low toxicity and is not believed to cause serious adverse effects at high intakes."[32]

Iodine

NHANES data indicate that most women do not take supplements containing iodine during pregnancy (approximately 18 to 20% of pregnant women take iodine-containing supplements).[6] While iodine is an important nutrient of concern during pregnancy,[1,13] there is

460 little data on how much iodine is in different foods and beverages.[33] This information is not
461 currently included in the USDA Food Data Central database,[34] and therefore was not included in
462 the Food Pattern Modeling Report[15] from the 2020-2025 DGAC nor in the models developed
463 from that information. Iodine was also not included in the modeled "composite prenatal
464 supplement" generated from the ODS DSLD.[35]
465
466 **Limitations**
467 While diet quality scores do tend to be higher during pregnancy, like the rest of the U.S.
468 population, most pregnant women in the U.S. do not follow DGA recommendations. Therefore,
469 the calculations of the nutrient adequacy of various vegetarian eating patterns in these analyses
470 provide only a snapshot of idealized ovo-vegetarian, lacto-vegetarian, pescatarian, and vegan
471 diets, and they do not and cannot provide an accurate estimate of the actual shortfalls of the
472 vegetarian diets of pregnant women in the U.S.
473
474 **Conclusions**
475 This study used Food Pattern Modeling to assess the nutritional adequacy of the 2020-
476 2025 DGA HVDP and four adapted dietary patterns—ovo-vegetarian, lacto-vegetarian, vegan,
477 and pescatarian—for women during pregnancy, both with and without the addition of prenatal
478 supplements. Across all examined energy levels (1800, 2000, 2200, 2400, and 2600 kcal per
479 day), different vegetarian dietary patterns can provide sufficient macronutrients, regardless of
480 supplement intake. Without prenatal supplements, each dietary pattern and energy level met
481 most, but not all, of the recommended levels for micronutrients. Micronutrients that were not met
482 varied, but were commonly vitamin D, iron, vitamin E, sodium, and choline. With prenatal

supplements, all dietary patterns at all energy levels met recommended micronutrient intake with three exceptions: vitamin D, choline, and sodium. Overall, these results show that a HVDP and similar diets without meat, eggs, dairy, and/or seafood can be nutritionally adequate for pregnant women, albeit with some micronutrient challenges, similar to those diets that include meat and animal products.

Too little information is available on the dietary patterns of pregnant women and of the dietary choices of any Americans who choose to follow primarily vegetarian eating patterns. Given the recent increase in maternal mortality in the U.S., the importance of nutrition throughout pregnancy, and the lack of detail in current dietary recommendations during pregnancy, this is an area of high importance for public health and merits future research. This manuscript highlights the many gaps in knowledge about the current eating choices and supplement choices of women during pregnancy as well as the nutrition needs of women during pregnancy.

References

1. United States Department of Agriculture, United States Department of Health and Human Services. *2020-2025 Dietary Guidelines for Americans*. 2020.

2. Yisahak S, Hinkle S, Mumford S, et al. Vegetarian diets during pregnancy, and maternal neonatal outcomes. *International Journal of Epidemiology*. 2021;50(1):165-178. doi:10.1093/ije/dyaa200

3. Hess JM, Comeau ME. Modeling lacto-vegetarian, pescatarian, and "pescavegan" USDA food patterns and assessing nutrient adequacy for healthy non-pregnant, non-lactating adults. *Frontiers in Nutrition*. 2023-February-07 2023;10doi:10.3389/fnut.2023.1113792

4. ACOG Committee Opinion No. 762: Prepregnancy Counseling. *Obstet Gynecol*. Jan 2019;133(1):e78-e89. doi:10.1097/aog.0000000000003013

5. MacKinnon KR, Lefkowitz A, Lorello GR, Schrewe B, Soklardis S, Kuper A. Recognizing and renaming in obstetrics: How do we take better care with language? *Obstetrics Medicine*. 2021;14(4):201-203. doi:10.117/1753495X211060191

6. Jun S, Gahche JJ, Potischman N, Dwyer JT, Guenther PM, Sauder KA, Bailey RL. Dietary Supplement Use and Its Micronutrient Contribution During Pregnancy and Lactation in the United States. *American Journal of Obstetrics and Gynecology*. 2020;135(3):623-633. doi:10.1097.0000000000003657

7. Institute of Medicine. *Dietary Reference Intakes for Thiamin, Riboflavin, Niacin, Vitamin B6, Folate, Vitamin B12, Pantothenic Acid, Biotin, and Choline*. 1998.

8. National Institutes of Health Office of Dietary Supplements. Iron Fact Sheet for Health Professionals. Accessed January 5, 2023, https://ods.od.nih.gov/factsheets/iron-healthprofessional/#ref

9. US Department of Health and Human Services, National Institutes of Health Office of Dietary Supplements. Dietary Supplement Label Database (DSLD). Accessed November 7, 2022. https://dsld.nlm.nih.gov/dsld/

10. Gusev P, Andrews K, Tey P, et al. Nutrient Strength and Dissolution Test Results of Nationally Representative Prescription Prenatal Multivitamin/Mineral (RxP MVM) Supplements. *Current Developments in Nutrition* 2022;6(Supplement 1):656. doi:10.1093/cdn/nzac061.040

11. Andrews K, Gusev P, Savarala S, et al. How Accurate Is the Labeled Content of Prescription Prenatal Multivitamin/mineral (MVM)? -an Analytical Pilot Study for the Dietary Supplement Ingredient Database (DSID) (OR14-08-19). *Current Developments in Nutrition*. 2019;3(Supplement 1)doi:10.1093/cdn/nzz039.OR14-08-19

12. Hoyert D. *Center for Disease Control and Prevention Maternal Mortality Rates in the United States, 2021*. 2023. Accessed 2/2/2024.

13. National Institutes of Health Office of Dietary Supplements. Iodine Fact Sheet for Health Professionals. https://ods.od.nih.gov/factsheets/Iodine-HealthProfessional/

14. Committee DGA. *Scientific Report of the 2020 Dietary Guidelines Advisory Committee*. United States Department of Agriculture, United States Department of Health and Human Services; 2020.

15. Dietary Guidelines Advisory Committee. *Food Pattern Modeling: Ages 2 Years and Older*. 2020.

16. NASEM. *Dietary Reference Intakes for Sodium and Potassium* 2019. Accessed 2/19/2020. https://doi.org/10.17226/25353

17. Center for Disease Control and Prevention. NCHS Ethics Review Board (ERB) Approval. Accessed 8/21/2022, https://www.cdc.gov/nchs/nhanes/irba98.htm

18. Branum A, Bailey R, Singer B. Dietary Supplement Use and Folate Status during Pregnancy in the United States. *Journal of Nutrition*. 2013;143(4):486-492. doi:10.3945/jn.112.169987

19. Hess J. Modeling Dairy-Free Vegetarian and Vegan USDA Food Patterns for Nonpregnant, Nonlactating Adults. *The Journal of Nutrition*. 2022;doi:https://doi.org/10.1093/jn/nxac100

20. Hess JM, Fulgoni VL, Radlowski EC. Modeling the Impact of Adding a Serving of Dairy Foods to the Healthy Mediterranean-Style Eating Pattern Recommended by the 2015–2020 Dietary Guidelines for Americans. *Journal of the American College of Nutrition*. 2019/01/02 2019;38(1):59-67. doi:10.1080/07315724.2018.1485527

21. Hemler E, Hu F. Plant-Based Diets for Personal, Population, and Planetary Health. *Advances in Nutrition*. 2019;10(4):S275-S283. doi:10.1093/advances/nmy117

22. The World Health Organization. WHO recommendations on antenatal care for a positive pregnancy experience: Nutritional interventions update on multiple micronutrient supplements during pregnancy. http://www.who.int

23. National Institutes of Health Office of Dietary Supplements. Multivitamin/mineral Supplements. Accessed January 25 2023, 2023. https://ods.od.nih.gov/factsheets/MVMS-HealthProfessional/#en56

24. Marra MV, Bailey RL. Position of the Academy of Nutrition and Dietetics: Micronutrient Supplementation. *J Acad Nutr Diet*. Nov 2018;118(11):2162-2173. doi:10.1016/j.jand.2018.07.022

25. Catherine S. Bradley, Colleen M. Kennedy, Anne M. Turcea, Satish S. C. Rao, Ingrid E. Nygaard. Constipation in Pregnancy. *Obstetrics & Gynecology*. 2007;110(6):1351-1357. doi:10.1097/01.AOG.0000295723.94624.b1

26. Abbi D. Lane-Cordova, Lara R. Schneider, William C. Tucker, James W. Cook, Sara Wilcox, Liu J. Dietary Sodium, Potassium, and Blood Pressure in Normotensive Pregnant Women: the National Health and Nutrition Examination Survey. *Applied Physiology, Nutrition, and Metabolism*. 2020;45(2)doi:10.1139/apnm-2019-0186

27. Maryam Kebbe, Emily W. Flanagan, Joshua R. Sparks, Redman LM. Eating Behaviors and Dietary Patterns of Women during Pregnancy: Optimizing the Universal 'Teachable Moment'. *Nutrients*. 21 September 2021 2021;13(9)doi:10.3390/nu13093298

28. National Institutes of Health Office of Dietary Supplements. Vitamin B6 Fact Sheet for Health Professionals. 2023. https://ods.od.nih.gov/factsheets/vitaminb6-HealthProfessional/

29. National Institutes of Health Office of Dietary Supplements. Vitamin B12 Fact Sheet for Health Professionals. 2023. https://ods.od.nih.gov/factsheets/vitaminb12-HealthProfessional/

30. National Institutes of Health Office of Dietary Supplements. Vitamin A and Carotenoids Fact Sheet for Health Professionals. 2023. https://ods.od.nih.gov/factsheets/vitaminA-HealthProfessional/

31. National Institutes of Health Office of Dietary Supplements. Folate Fact Sheet for Health Professionals.

32. National Institutes of Health Office of Dietary Supplements. Vitamin C Fact Sheet for Health Professionals. Accessed February 2, 2023, https://ods.od.nih.gov/factsheets/vitaminC-HealthProfessional/

587 33. Ershow AG, Haggans CJ, Roseland JM, et al. Databases of Iodine Content of Foods and
588 Dietary Supplements–Availability of New and Updated Resources. *Journal of the Academy of*
589 *Nutrition and Dietetics*. 2022/07/01/ 2022;122(7):1229-1231.
590 doi:https://doi.org/10.1016/j.jand.2022.03.017
591 34. USDA. FoodData Central https://fdc.nal.usda.gov/fdc-app.html#/food-
592 details/746767/nutrients
593 35. National Institutes of Health Office of Dietary Supplements. Dietary Supplement Label
594 Database (DSLD). https://ods.od.nih.gov/Research/Dietary_Supplement_Label_Database.aspx

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596

Table 1. Daily or Weekly Amounts for each food group in the 2000 kcal/day Healthy Vegetarian Dietary Pattern (HVDP) from the 2020-2025 Dietary Guidelines for Americans compared with modeled dietary patterns

Food Groups	**HVDP**	**Model 1: Ovo-vegetarian**	**Model 2: Vegan**	**Model 3: Lacto-vegetarian**	**Model 4: Pescatarian**
Vegetables, cup eq/d	2.5	2.5	2.5	2.5	2.5
Dark Green Vegetables, cup eq/wk	1.5	1.5	1.5	1.5	1.5
Red and Orange Vegetables, cup eq/wk	5.5	5.5	5.5	5.5	5.5
Beans, Peas, Lentils, cup eq/wk	1.5	1.5	1.5	1.5	1.5
Starchy Vegetables, cup eq/wk	5	5	5	5	5
Other Vegetables, cup eq/wk	4	4	4	4	4
Fruits, cup eq/d	2	2	2	2	2
Grains, oz eq/d	6.5	6.5	6.5	6.5	6
Whole Grains, oz eq/d	3.5	3.5	3.5	3.5	3.5
Refined Grains, oz eq/d	3	3	3	3	2.5
Dairy, cup eq/d	3	0	0	3	3
DairyALT[a], cup eq/d	0	3	3	0	0
Protein Foods, oz eq/d	3.5	3.5	3.5	3.5	4.6
Eggs, oz eq/wk	3	3	0	0	3
Beans, Peas, Lentils, oz eq/wk	6	6	7	7	6
Soy Products, oz eq/wk	8	8	9	9	8
Nuts, Seeds, oz eq/wk	7	7	8	8	7
Seafood, oz eq/wk	0	0	0	0	8

[a] DairyALT indicates “dairy alternative.” This food group is comprised of fortified soy milk and soy yogurt, the only plant-based alternatives to dairy foods recommended by the 2020-2025 Dietary Guidelines for Americans.

Oils, g/d	27	27	27	27	27
Discretionary Calories, kcal/d	250	250	250	250	250

Table 2. Prenatal Supplement Composite developed from commonly included nutrients in retail prenatal supplement products according to the Office of Dietary Supplements Dietary Supplement Label Database

Common nutrients in prenatal supplements	**Average amount of nutrient in prenatal supplements**
Calcium (mg)	206.75
Folic acid (mcg DFE)	710.67
Iron (mg)	25.52
Niacin (mg)	16.17
Riboflavin (mg)	1.88
Vitamin A (mcg RAE)	1008.06
Vitamin B6 (mg)	7.43
Vitamin C (mg)	106.49
Vitamin E (mg)	14.63
Zinc (mg)	18.50

Table 4. 2000 kcal/day Ovo-Vegetarian and Vegan Models of a Healthy Vegetarian Dietary Pattern during Pregnancy[a]

2000	**Source of Goal used for Nutrient Level**	**Nutritional Goals: Trimester 1 – females 19-30**	**Healthy Vegetarian Dietary Pattern (HVDP)**	**Model 1: Ovo-Vegetarian (2000 kcal)**	**% of goal**	**Model 2: Vegan (2000 kcal)**	**% of goal**
ENERGY/MACRONUTRIENTS							
Calories (kcal)	DGA	2000	1998	2072	103.58%	2065	103.26%
Protein (g)	RDA	71	80	72	101.01%	72	100.97%
Protein (% kcal)	AMDR	10-35% of calories	16.01%	13.90%	Within range	13.95%	Within range
Carbohydrate (g)	RDA	175	250	254	144.86%	255	145.74%
Carbohydrate (% kcal)	AMDR	45-65% of calories	50.05%	49.03%	Within range	49.39%	Within range
Fiber (g)	RDA	28	29.9	30.8	110.10%	31.4	112.31%

[a] This table reflects nutrient values that do not include prenatal supplements.

Total Fat (g)	DGA	20-35% of calories	54.3	62.3	Within range	61.3	Within range
Total Fat (% kcal)	AMDR	20-35% of calories	24.46%	27.06%	Within range	26.72%	Within range
Saturated Fat (g)	DGA	<10% of calories	10.2	10.0	Within limits	9.5	Within limits
Saturated Fat (% kcal)	DGA	<10% of calories	4.59%	4.34%	Within limits	4.14%	Within limits
Monounsaturated Fatty Acids (g)	n/a	n/a	19.5	21	n/a	21	n/a
Polyunsaturated Fatty Acids (g)	n/a	n/a	20.6	26	n/a	26	n/a
18:2 Linoleic acid (g)	AI	13	18.2	22	168.97%	22	169.57%
18:3 Linolenic acid (g)	AI	1.4	2.34	3	201.59%	3	203.27%

EPA (20:5 n-3) (g)	n/a	n/a	0.00	0	n/a	0	n/a
DHA (22:6 n-3) (g)	n/a	n/a	0.01	0	n/a	0	n/a
Cholesterol (mg)	DGA	as low as possible	105	83	n/a	3	n/a
MINERALS							
Calcium (mg)	RDA	1000	1341	1325	132.46%	1326	132.57%
Iron (mg)	RDA	27	16	19	70.39%	19	71.22%
Magnesium (mg)	RDA	350	381	408	116.51%	414	118.24%
Phosphorus (mg)	RDA	700	1609	1236	176.58%	1232	175.94%
Potassium (mg)	AI	2900	3272	3323	114.58%	3334	114.95%
Sodium (mg)	CDRR	2300	1461	1205	52.37%	1198	52.10%
Zinc (mg)	RDA	11	11	10	86.42%	9	86.25%
Copper (mg)	RDA	1	2	3	259.27%	3	265.10%
Selenium (mcg)	RDA	30	79	73	122.43%	67	112.26%

VITAMINS							
Vitamin A, RAE (mcg)	RDA	750	847	907	121.00%	875	116.73%
Vitamin E, AT (mg)	RDA	15	10.24	10.87	72.48%	10.93	72.88%
Vitamin D (IU)	RDA	600	220	370	61.63%	352	58.59%
Vitamin C (mg)	RDA	85	129	137	161.26%	137	161.31%
Thiamin (mg)	RDA	1.4	1.79	1.76	125.61%	1.76	126.04%
Riboflavin (mg)	RDA	1.4	1.82	2.12	151.66%	2.02	144.63%
Niacin (mg)	RDA	18	16.5	18.2	101.02%	18.4	102.25%
Vitamin B_6 (mg)	RDA	1.9	1.83	1.77	93.27%	1.77	92.97%
Vitamin B_{12} (mcg)	RDA	2.6	3.85	6.79	261.18%	6.55	251.92%
Choline (mg)	AI	450	300	381	84.71%	325	72.16%
Vitamin K (mcg)	AI	90	139	158	175.46%	158	175.72%

Folate (mcg DFE[b])	RDA	600	615	647	107.83%	607	101.17%

[b] DFE = Dietary Folate Equivalent

Table 5. 2000 kcal/day Lacto-Vegetarian and Pescatarian Models of a Healthy Vegetarian Dietary Pattern during Pregnancy[a]

2000	**Source of Goal used for Nutrient Level**	**Nutritional Goals: Trimester 1 – females 19-30**	**Model 3: Lacto-vegetarian (2000 kcal)**	**% of goal**	**Model 4: Pescatarian (2000 kcal)**	**% of goal**
ENERGY/MACRONUTRIENTS						
Calories (kcal)	DGA	2000	1991	99.56%	2000	99.99%
Protein (g)	RDA	71	80	112.40%	86	121.10%
Protein (% kcal)	AMDR	10-35% of calories	16.07%	Within range	17.20%	Within range
Carbohydrate (g)	RDA	175	251	143.63%	242	138.19%
Carbohydrate (% kcal)	AMDR	45-65% of calories	50.43%	Within range	48.40%	Within range
Fiber (g)	14 g/1000 kcal	28	30.6	109.13%	29.6	105.65%
Total Fat (g)	AMDR	20-35% of calories	53.3	Within range	55.2	Within range
Total Fat (% kcals)	AMDR	20-35% of calories	24.09%	Within range	24.84%	Within range

[a] This table reflects nutrient values that do not include prenatal supplements.

Saturated Fat (g)	DGA	<10% of calories	9.7	Within limits	10.4	Within limits
Saturated Fat (% kcal)	DGA	<10% of calories	4.38%	Within limits	4.68%	Within limits
Monounsaturated Fatty Acids (g)	n/a	n/a	19	n/a	20	n/a
Polyunsaturated Fatty Acids (g)	n/a	n/a	21	n/a	21	n/a
18:2 Linoleic acid (g)	AI	13	18	140.49%	18	139.42%
18:3 Linolenic acid (g)	AI	1.4	2	168.99%	2	167.55%
EPA (20:5 n-3) (g)	n/a	n/a	0	n/a	0.073	n/a
DHA (22:6 n-3) (g)	n/a	n/a	0	n/a	0.165	n/a
Cholesterol (mg)	DGA	as low as possible	25	n/a	131	n/a
MINERALS						
Calcium (mg)	RDA	1000	1342	134.19%	1340	133.97%

Iron (mg)	RDA	27	17	61.66%	16	59.95%
Magnesium (mg)	RDA	350	387	110.71%	388	110.54%
Phosphorus (mg)	RDA	700	1604	229.17%	1647	239.07%
Potassium (mg)	AI	2900	3282	113.19%	3360	115.85%
Sodium (mg)	CDRR	2300	1455	63.26%	1494	64.95%
Zinc (mg)	RDA	11	11	103.98%	12	106.55%
Copper (mg)	RDA	1	2	169.10%	2	166.68%
Selenium (mcg)	RDA	30	73	121.81%	92	153.08%
VITAMINS						
Vitamin A, RAE (mcg)	RDA	750	815	108.64%	855	113.95%
Vitamin E, AT (mg)	RDA	15	10.30	68.68%	10.50	70.00%
Vitamin D (IU)	RDA	600	202	33.59%	298	49.71%
Vitamin C (mg)	RDA	85	130	152.38%	130	152.56%
Thiamin (mg)	RDA	1.4	1.79	128.19%	1.74	124.64%
Riboflavin (mg)	RDA	1.4	1.72	123.20%	1.81	129.52%

Niacin (mg)	RDA	18	16.7	92.92%	17.7	98.10%
Vitamin B_6 (mg)	RDA	1.9	1.83	96.13%	1.92	100.86%
Vitamin B_{12} (mcg)	RDA	2.6	3.61	138.85%	5.02	192.99%
Choline (mg)	AI	450	243	54.01%	320	71.13%
Vitamin K (mcg)	AI	90	139	154.15%	138	153.69%
Folate (mcg DFE)[b]	RDA	600	616	102.67%	599	99.83%

[b] DFE = Dietary Folate Equivalent

Supplemental Table 1. Nutrients in Prenatal Supplement

Nutrient name	**Additional nutrient forms in Office of Dietary Supplements' Dietary Supplement Label Database included in prenatal supplement composite**
Vitamin C	Ascorbic Acid
Vitamin D	Cholecalciferol, vitamin D3, vitamin D3
Vitamin B12	Cyanocobalamin
Folic Acid	Folate
Thiamine	Vitamin B1, thiamin mononitrate, thiamin hydrochloride
Riboflavin	Vitamin B2
Niacin	Vitamin B3, Niacinamide
Pantothenic Acid	Vitamin B5
Vitamin K	Vitamin K1/K2, vitamin K2

Supplemental Table 3. Seafood food group developed from the 2020 Dietary Guidelines for Americans Food Pattern Modeling Report

Nutrients	**Seafood Food Group** (1 ounce-equivalent)
ENERGY/MACRONUTRIENTS	
Calories (kcal)	39.76
Protein (g)	6.43
Carbohydrate (g)	0.12
Fiber (g)	0.00
Total fat (g)	1.34
Saturated Fat (g)	0.30
Monounsaturated fat (g)	0.44
Polyunsaturated fat (g)	0.44
Linoleic acid (18:2n-6) (g)	0.09
Linolenic acid (18:3) (g)	0.02
EPA (20:5n-3) (g)	0.06
DHA (22:6n-3) (g)	0.14
Cholesterol (mg)	22.85
MINERALS	
Calcium (mg)	9.41
Iron (mg)	0.21
Magnesium (mg)	9.09
Phosphorus (mg)	73.85

Potassium (mg)	91.48
Sodium (mg)	74.49
Zinc (mg)	0.33
Copper (mg)	0.05
Selenium (mg)	13.87
VITAMINS	
Vitamin A, RAE (mcg)	10.51
Vitamin E, AT (mg)	0.28
Vitamin D (IU)	69.82
Vitamin C (mg)	0.40
Thiamin (mg)	0.03
Riboflavin (mg)	0.03
Niacin (mg)	1.55
Vitamin B6 (mg)	0.09
Vitamin B12 (mcg)	1.05
Choline (mg)	19.49
Vitamin K (mcg)	0.10
Folate (mcg)	5.09

Supplemental Table 6. 1800 kcal/day Ovo-Vegetarian and Vegan Models of a Healthy Vegetarian Dietary Pattern during Pregnancy[a]

1800	**Source of Goal used for Nutrient Level[b]**	**Nutritional Goals: Trimester 1 – Females 31-50**	**Healthy Vegetarian Dietary Pattern (HVDP)**	**Model 1: Ovo-Vegetarian (1800 kcal)**	**% of goal**	**Model 2: Vegan (1800 kcal)**	**% of goal**
ENERGY/MACRONUTRIENTS							
Calories (kcal)	DGA	1800	1797	1871	103.92%	1864	103.53%
Protein (g)	RDA	71	76	67	94.99%	67	94.78%
Protein (% kcal)	AMDR	10-35% of kcal	16.92%	14.32%	Within range	14.38%	Within range
Carbohydrate (g)	RDA	175	237	241	137.47%	242	138.36%

[a] This table reflects nutrient values that do not include prenatal supplements.

[b] AI = Adequate Intake, AMDR = Acceptable Macronutrient Distribution Range, CDRR = Chronic Disease Risk Reduction, DGA = 2020-2025 Dietary Guidelines for Americans, RDA = Recommended Dietary Allowance

Carbohydrate (% kcal)	AMDR	45-65% of kcal	52.75%	51.52%	Within range	51.93%	Within range
Fiber (g)	14g/1000 kcal	25	28.6	29.5	117.87%	30.1	120.34%
Total Fat (g)	DGA	20-35% of kcal	49.9	57.9	Within range	56.9	Within range
Total Fat (% kcal)	AMDR	20-35% of kcal	24.99%	27.85%	Within range	27%	Within range
Saturated Fat (g)	DGA	<10% of kcal	9.6	9.4	Within limit	8.8	Within limit
Saturated Fat (% kcal)	AMDR	<10% of kcal	4.81%	4.52%	Within limit	4.25%	Within limit
Monounsaturated Fatty Acids (g)	n/a	n/a	17.9	19.7	n/a	19.4	n/a
Polyunsaturated Fatty Acids (g)	n/a	n/a	18.7	24.3	n/a	24.4	n/a
18:2 Linoleic acid (g)	AI	13	16.5	20.3	156.26%	20.4	156.84%
18:3 Linolenic acid (g)	AI	1.4	2.12	2.60	185.46%	2.62	187.11%

EPA (20:5 n-3) (g)	n/a	n/a	0.00	0.00	n/a	0	n/a
DHA (22:6 n-3) (g)	n/a	n/a	0.01	0.01	n/a	0	n/a
Cholesterol (mg)	DGA	As low as possible	105	83	n/a	3	n/a
MINERALS							
Calcium (mg)	RDA	1000	1317	1301	130.06%	1301	130.14%
Iron (mg)	RDA	27	16	18	67.38%	18	68.13%
Magnesium (mg)	RDA	360	365	392	108.81%	398	110.47%
Phosphorus (mg)	RDA	700	1557	1184	169.17%	1179	168.38%
Potassium (mg)	AI	2900	3102	3154	108.75%	3164	109.11%
Sodium (mg)	CDRR	2300	1421	1165	50.64%	1157	50.31%
Zinc (mg)	RDA	11	11	9	83.63%	9	83.41%
Copper (mg)	RDA	1	2	2	246.79%	3	252.40%
Selenium (mcg)	RDA	60	79	73	121.32%	67	111.14%
VITAMINS							
Vitamin A, RAE (mcg)	RDA	770	839	899	116.81%	867	112.65%

Vitamin E, AT (mg)	RDA	15	9.40	10.03	66.84%	10.09	67.25%
Vitamin D (IU)	RDA	600	219	369	61.54%	351	58.51%
Vitamin C (mg)	RDA	85	114	122	143.56%	122	143.62%
Thiamin (mg)	RDA	1.4	1.75	1.72	122.57%	1.72	122.98%
Riboflavin (mg)	RDA	1.4	1.78	2.08	148.62%	1.98	141.57%
Niacin (mg)	RDA	18	16.0	17.69	98.27%	17.9	99.49%
Vitamin B_6 (mg)	RDA	1.9	1.74	1.68	88.33%	1.67	88.02%
Vitamin B_{12} (mcg)	RDA	2.6	3.85	6.79	261.18%	6.55	251.92%
Choline (mg)	AI	450	286	367.83	81.74%	311	69.12%
Vitamin K (mcg)	AI	90	133	152.26	169.18%	152	169.44%
Folate (mcg DFE[c])	RDA	600	594	625	104.17%	629	104.83%

[c] DFE = Dietary Folate Equivalent

Supplemental Table 7. 1800 kcal/day Lacto-Vegetarian and Pescatarian Models of a Healthy Vegetarian Dietary Pattern during Pregnancy[a]

1800	**Source of Goal used for Nutrient Level[b]**	**Nutritional Goals: Trimester 1 – Females 31-50**	**Model 3: Lacto-Vegetarian (1800 kcal)**	**% of goal**	**Model 4: Pescatarian (1800 kcal)**	**% of goal**
ENERGY/MACRONUTRIENTS						
Calories (kcal)	DGA	1800	1790	99.42%	1799	99.93%
Protein (g)	RDA	71	75	106.21%	82	115.08%
Protein (% kcal)	AMDR	10-35% of calories	16.76%	Within range	18.23%	Within range
Carbohydrate (g)	RDA	175	238	136.24%	229	130.81%

[a] This table reflects nutrient values that do not include prenatal supplements.

[b] AI = Adequate Intake, AMDR = Acceptable Macronutrient Distribution Range, CDRR = Chronic Disease Risk Reduction, DGA = 2020-2025 Dietary Guidelines for Americans, RDA = Recommended Dietary Allowances

Carbohydrate (% kcal)	AMDR	45-65% of kcal	53.18%	Within range	50.92%	Within range
Fiber (g)	14g/1000 kcal	25	29.2	116.77%	28.2	112.88%
Total Fat (g)	DGA	20-35% of kcal	48.9	Within range	50.8	Within range
Total Fat (% kcal)	AMDR	20-35% of kcal	24.59%	Within range	25.41%	Within range
Saturated Fat (g)	DGA	<10% kcal	9.1	Within limit	9.8	Within limit
Saturated Fat (% kcal)	AMDR	<10% of kcal	4.58%	Within limit	4.90%	Within limit
Monounsaturated Fatty Acids (g)	n/a	n/a	17.6	n/a	18.2	n/a
Polyunsaturated Fatty Acids (g)	n/a	n/a	18.8	n/a	19.1	n/a

18:2 Linoleic acid (g)	AI	13	16.6	127.77%	16.5	126.71%
18:3 Linolenic acid (g)	AI	1.4	2.14	152.83%	2.12	151.42%
EPA (20:5 n-3) (g)	n/a	n/a	0	n/a	0	n/a
DHA (22:6 n-3) (g)	n/a	n/a	0	n/a	0	n/a
Cholesterol (mg)	DGA	As low as possible	25	n/a	131	n/a
MINERALS						
Calcium (mg)	RDA	1000	1318	131.75%	1316	131.57%
Iron (mg)	RDA	27	16	58.58%	15	56.94%
Magnesium (mg)	RDA	360	371	103.15%	372	103.29%
Phosphorus (mg)	RDA	700	1551	221.60%	1622	231.66%
Potassium (mg)	AI	2900	3113	107.34%	3190	110.01%
Sodium (mg)	CDRR	2300	1414	61.46%	1454	63.21%
Zinc (mg)	RDA	11	11	101.14%	11	103.76%
Copper (mg)	RDA	1	2	156.40%	2	154.20%

Selenium (mcg)	RDA	60	72	120.69%	91	151.97%
VITAMINS						
Vitamin A, RAE (mcg)	RDA	770	807	104.76%	847	109.94%
Vitamin E, AT (mg)	RDA	15	9.46	63.05%	9.66	64.37%
Vitamin D (IU)	RDA	600	201	33.51%	298	49.63%
Vitamin C (mg)	RDA	85	114	134.69%	115	134.87%
Thiamin (mg)	RDA	1.4	1.75	125.12%	1.70	121.60%
Riboflavin (mg)	RDA	1.4	1.68	120.14%	1.77	126.47%
Niacin (mg)	RDA	18	16.2	90.15%	17.2	95.35%
Vitamin B_6 (mg)	RDA	1.9	1.73	91.17%	1.82	95.91%
Vitamin B_{12} (mcg)	RDA	2.6	3.61	138.85%	5.02	192.99%
Choline (mg)	AI	450	229	50.98%	307	68.15%
Vitamin K (mcg)	AI	90	133	147.87%	133	147.41%
Folate (mcg DFE[c])	RDA	600	598	99.67%	577	96.17%

[c] DFE = Dietary Folate Equivalents

Supplemental Table 8. 2200 kcal/day Ovo-Vegetarian and Vegan Models of a Healthy Vegetarian Dietary Pattern during Pregnancy[a]

2200	**Source of Goal used for Nutrient Level[b]**	**Nutritional Goals: Trimester 2 – females 31-50**	**Healthy Vegetarian Dietary Pattern (HVDP)**	**Model 1: Ovo-Vegetarian (2200 kcal)**	**% of goal**	**Model 2: Vegan (2200 kcal)**	**% of goal**
ENERGY/MACRONUTRIENTS							
Calories (kcal)	DGA	2200	2201	2275	103.42%	2271	103.23%
Protein (g)	RDA	71	85	77	108.23%	77	108.41%
Protein (% kcals)	AMDR	10-35% of calories	15.45%	13.54%	Within range	13.56%	Within range
Carbohydrate (g)	RDA	175	277	281	160.56%	283	161.69%

[a] This table reflects nutrient values that do not include prenatal supplements.

[b] AI = Adequate Intake, AMDR = Acceptable Macronutrient Distribution Range, CDRR = Chronic Disease Risk Reduction, DGA = 2020-2025 Dietary Guidelines for Americans, RDA = Recommended Dietary Allowance

Carbohydrate (% kcals)	AMDR	45-65% of calories	50.3%	49.41%	Within range	49.85%	Within range
Fiber (g)	14g/1000 kcal	31	33.8	34.7	112.05%	35.5	114.53%
Total Fat (g)	DGA	20-35% kcal	58.5	66.5	Within range	65.5	Within range
Total Fat (% kcals)	AMDR	20-35% of kcal	23.92%	26.31%	Within range	26%	Within range
Saturated Fat (g)	DGA	<10% kcal	11.0	10.7	Within limits	10.2	Within limits
Saturated Fat (% kcals)	DGA	<10% of kcal	4.50%	4.23%	Within limits	4.04%	Within limits
Monounsaturated Fatty Acids (g)	n/a	n/a	21.0	22.8	n/a	22.5	n/a
Polyunsaturated Fatty Acids (g)	n/a	n/a	22.3	27.9	n/a	27.9	n/a

18:2 Linoleic acid (g)	AI	13	19.7	23.4	180.31%	23.5	180.94%
18:3 Linolenic acid (g)	AI	1.4	2.54	3.02	215.80%	3.05	217.64%
EPA (20:5 n-3) (g)	n/a	n/a	0.00	0.00	n/a	0.00	n/a
DHA (22:6 n-3) (g)	n/a	n/a	0.00	0.01	n/a	0.00	n/a
Cholesterol (mg)	DGA	As low as possible	106	83	n/a	3	n/a
MINERALS							
Calcium (mg)	RDA	1000	1392	1375	137.54%	1377	137.73%
Iron (mg)	RDA	27	18	21	77.81%	21	78.79%
Magnesium (mg)	RDA	360	419	445	123.74%	452	125.68%
Phosphorus (mg)	RDA	700	1718	1345	192.19%	1344	191.93%
Potassium (mg)	AI	2900	35	3626	125.04%	3644	125.66%

Sodium (mg)	CDRR	2300	1573	1317	57.24%	1310	56.97%
Zinc (mg)	RDA	11	12	10	95.15%	10	95.15%
Copper (mg)	RDA	1	2	3	274.45%	3	280.66%
Selenium (mcg)	RDA	60	87	81	134.99%	75	124.93%
VITAMINS							
Vitamin A, RAE (mcg)	RDA	770	916	977	126.87%	945	122.71%
Vitamin E, AT (mg)	RDA	15	11.11	12	78.29%	12	78.76%
Vitamin D (IU)	RDA	600	223	373	62.16%	355	59.12%
Vitamin C (mg)	RDA	85	142	149	175.85%	150	175.91%
Thiamin (mg)	RDA	1.4	2.01	1.98	141.60%	1.99	142.27%
Riboflavin (mg)	RDA	1.4	1.93	2.23	159.00%	2.13	152.04%
Niacin (mg)	RDA	18	18.6	20.2	112.49%	20.5	113.76%
Vitamin B_6 (mg)	RDA	1.9	2.03	1.97	103.59%	1.97	103.44%

Vitamin B_{12} (mcg)	RDA	2.6	3.98	6.92	265.99%	6.68	256.73%
Choline (mg)	AI	450	318	399	88.74%	343	76.29%
Vitamin K (mcg)	AI	90	170	189	210.51%	190	210.84%
Folate (mcg DFE[c])	RDA	600	697	729	121.50%	735	122.50%

[c] DFE = Dietary Folate Equivalent

Supplemental Table 9. 2200 kcal/day Lacto-Vegetarian and Pescatarian Models of a Healthy Vegetarian Dietary Pattern during Pregnancy[a]

2200	**Source of Goal used for Nutrient Level[b]**	**Nutritional Goals: Trimester 2 – females 31-50**	**Model 3: Lacto-vegetarian (2200 kcal)**	**% of goal**	**Model 4: Pescatarian (2200 kcal)**	**% of goal**
ENERGY/MACRONUTRIENTS						
Calories (kcal)	DGA	2200	2197	99.86%	2209	100.41%
Protein (g)	RDA	71	85	119.72%	92	129.58%
Protein (% kcal)	AMDR	10-35% of kcals	15.48%	Within range	16.66%	Within range
Carbohydrate (g)	RDA	175	279	159.43%	269	153.71%
Carbohydrate (% kcal)	AMDR	45-65% of kcals	50.80%	Within range	48.71%	Within range
Fiber (g)	14 g/1000 kcal	31	35	112.90%	33	106.45%

[a] This table reflects nutrient values that do not include prenatal supplements.

[b] AI = Adequate Intake, AMDR = Acceptable Macronutrient Distribution Range, CDRR = Chronic Disease Risk Reduction, DGA = 2020-2025 Dietary Guidelines for Americans, RDA = Recommended Dietary Allowance

Total Fat (g)	DGA	20-35% kcal	58	Within range	60	Within range
Total Fat (% kcal)	AMDR	20-35% of kcal	23.76%	Within range	24 %	Within range
Saturated Fat (g)	DGA	<10% kcal	10	Within limits	11	Within limits
Saturated Fat (% kcal)	DGA	<10% of kcal	4.10%	Within limit	4.48%	Within limit
Monounsaturated Fatty Acids (g)	n/a	n/a	21	n/a	21	n/a
Polyunsaturated Fatty Acids (g)	n/a	n/a	22	n/a	23	n/a
18:2 Linoleic acid (g)	AI	13	20	153.85%	20	153.85%
18:3 Linolenic acid (g)	AI	1.4	3	214.29%	3	214.29%

EPA (20:5 n-3) (g)	n/a	n/a	0	n/a	0.082	n/a
DHA (22:6 n-3) (g)	n/a	n/a	0	n/a	0.185	n/a
Cholesterol (mg)	DGA	As low as possible	25	n/a	135	n/a
MINERALS						
Calcium (mg)	RDA	1000	1393	139.30%	1392	139.20%
Iron (mg)	RDA	27	19	70.37%	18	66.67%
Magnesium (mg)	RDA	360	426	118.33%	427	118.61%
Phosphorus (mg)	RDA	700	1716	245.14%	1794	256.29%
Potassium (mg)	AI	2900	3593	123.90%	3676	126.76%
Sodium (mg)	CDRR	2300	1567	68.13%	1617	70.30%
Zinc (mg)	RDA	11	12	109.09%	13	118.18%
Copper (mg)	RDA	1	2	200.00%	2	200.00%
Selenium (mcg)	RDA	60	81	135.00%	101	168.33%
VITAMINS						
Vitamin A, RAE (mcg)	RDA	770	884	114.81%	926	120.26%

Vitamin E, AT (mg)	RDA	15	11	73.33%	11	73.33%
Vitamin D (IU)	RDA	600	205	34.17%	312	52.00%
Vitamin C (mg)	RDA	85	142	167.06%	142	167.06%
Thiamin (mg)	RDA	1.4	2	142.86%	2	142.86%
Riboflavin (mg)	RDA	1.4	2	142.86%	2	142.86%
Niacin (mg)	RDA	18	19	105.56%	20	111.11%
Vitamin B_6 (mg)	RDA	1.9	2	105.26%	2	105.26%
Vitamin B_{12} (mcg)	RDA	2.6	4	153.85%	5	192.31%
Choline (mg)	AI	450	262	58.22%	341	75.78%
Vitamin K (mcg)	AI	90	170	188.89%	170	188.89%
Folate (mcg DFE[c])	RDA	600	704	117.33%	681	113.50%

[c] DFE = Dietary Folate Equivalent

Supplemental Table 10. 2400 kcal/day Ovo-Vegetarian and Vegan Models of a Healthy Vegetarian Dietary Pattern during Pregnancy[a]

2400	**Source of Goal used for Nutrient Level[b]**	**Nutritional Goals: Trimester 2 – females 19-30**	**Healthy Vegetarian Dietary Pattern (HVDP)**	**Model 1: Ovo-Vegetarian (2400 kcal)**	**% of goal**	**Model 2: Vegan (2400 kcal)**	**% of goal**
ENERGY/MACRONUTRIENTS							
Calories (kcal)	DGA	2400	2404	2478	103.26%	2474	103.10%
Protein (g)	RDA	71	91	83	116.87%	83	116.93%
Protein (% kcal)	AMDR	10-35% of kcal	15.14%	13.40%	Within range	13.42%	Within range
Carbohydrate (g)	RDA	175	297	301	171.98%	303	173.13%
Carbohydrate (% kcal)	AMDR	45-65% of kcal	49.42%	48.59%	Within range	48.99%	Within range

[a] This table reflects nutrient values that do not include prenatal supplements.

[b] AI = Adequate Intake, AMDR = Acceptable Macronutrient Distribution Range, CDRR = Chronic Disease Risk Reduction, DGA = 2020-2025 Dietary Guidelines for Americans, RDA = Recommended Dietary Allowance

Fiber (g)	14 g/1000 kcal	34	36.6	37	110.16%	38	112.46%
Total Fat (g)	DGA	20-35% kcal	63.2	71	Within range	70	Within range
Total Fat (% kcal)	AMDR	25-35% of kcal	23.66%	25.79%	Within range	25.46%	Within range
Saturated Fat (g)	DGA	<10% kcal	11.7	12	Within limits	11	Within limit
Saturated Fat (% kcal)	DGA	DGA	4.38%	<10% of kcal	4.36%	Within limit	4.00%
Monounsaturated Fatty Acids (g)	n/a	n/a	22.7	24	n/a	24	n/a
Polyunsaturated Fatty Acids (g)	n/a	n/a	24.2	30	n/a	30	n/a
18:2 Linoleic acid (g)	AI	13	21.3	25	193.25%	25	194.02%

18:3 Linolenic acid (g)	AI	1.4	2.74	3	229.80%	3	231.71%
EPA (20:5 n-3) (g)	n/a	n/a	0.00	0	n/a	0	n/a
DHA (22:6 n-3) (g)	n/a	n/a	0.01	0	n/a	0	n/a
Cholesterol (mg)	DGA	As low as possible	106	84	n/a	4	n/a
MINERALS							
Calcium (mg)	RDA	1000	1436	1420	141.98%	1422	142.16%
Iron (mg)	RDA	27	20	23	84.92%	23	85.84%
Magnesium (mg)	RDA	350	450	476	135.96%	483	138.02%
Phosphorus (mg)	RDA	700	1822	1450	207.10%	1447	206.78%
Potassium (mg)	AI	2900	3704	3755	129.48%	3774	130.13%
Sodium (mg)	CDRR	2300	1684	1427	62.05%	1420	61.73%
Zinc (mg)	RDA	11	13	11	103.51%	11	103.51%
Copper (mg)	RDA	1	2	3	222.10%	3	226.81%
Selenium (mcg)	RDA	60	94	88	147.23%	82	137.18%

VITAMINS							
Vitamin A, RAE (mcg)	RDA	750	935	996	132.82%	964	128.56%
Vitamin E, AT (mg)	RDA	15	11.94	13	83.81%	13	84.40%
Vitamin D (IU)	RDA	600	227	377	62.76%	358	59.73%
Vitamin C (mg)	RDA	85	143	150	176.64%	150	176.71%
Thiamin (mg)	RDA	1.4	2.18	2	153.92%	2	154.59%
Riboflavin (mg)	RDA	1.4	2.00	2	164.55%	2	157.61%
Niacin (mg)	RDA	18	20.2	22	121.65%	22	122.99%
Vitamin B_6 (mg)	RDA	1.9	2.13	2	108.94%	2	108.82%
Vitamin B_{12} (mcg)	RDA	2.6	4.10	7	270.80%	7	261.54%
Choline (mg)	AI	450	332	413	91.88%	357	79.40%
Vitamin K (mcg)	AI	90	174	193	214.91%	194	215.24%
Folate (mcg DFE[c])	RDA	600	697	757	126.17%	804	134.00%

[c] DFE = Dietary Folate Equivalent

Supplemental Table 11. 2400 kcal/day Lacto-Vegetarian and Pescatarian Models of a Healthy Vegetarian Dietary Pattern during Pregnancy[a]

2400	**Source of Goal used for Nutrient Level[b]**	**Nutritional Goals: Trimester 2 – females 19-30**	**Model 3: Lacto-vegetarian (2400 kcal)**	**% of goal**	**Model 4: Pescatarian (2400 kcal)**	**% of goal**
ENERGY/MACRONUTRIENTS						
Calories (kcal)	DGA	2400	2401	100.04%	2478	103.25%
Protein (g)	RDA	71	91	128.17%	83	116.90%
Protein (% kcal)	AMDR	10-35% of kcal	15.16%	Within range	16.38%	Within range
Carbohydrate (g)	RDA	175	299	170.86%	301	172.00%
Carbohydrate (% kcal)	AMDR	45-65% of kcal	47.82%	Within range	47.81%	Within range
Fiber (g)	14 g/1000 kcal	34	37	108.82%	37	108.82%

[a] This table reflects nutrient values that do not include prenatal supplements.

[b] AI = Adequate Intake, AMDR = Acceptable Macronutrient Distribution Range, CDRR = Chronic Disease Risk Reduction, DGA = 2020-2025 Dietary Guidelines for Americans, RDA = Recommended Dietary Allowance

Total Fat (g)	DGA	20-35% kcal	62	Within range	65	Within range
Total Fat (% kcal)	AMDR	20-35% of kcal	23.24%	Within range	24.19%	Within range
Saturated Fat (g)	DGA	<10% kcal	11	Within limit	12	Within limit
Saturated Fat (% kcal)	DGA	<10% kcal	4.12%	Within limit	4.47%	Within limit
Monounsaturated Fatty Acids (g)	n/a	n/a	22	n/a	24	n/a
Polyunsaturated Fatty Acids (g)	n/a	n/a	24	n/a	30	n/a
18:2 Linoleic acid (g)	AI	13	21	161.54%	25	192.31%
18:3 Linolenic acid (g)	AI	1.4	3	214.29%	3	214.29%
EPA (20:5 n-3) (g)	n/a	n/a	0	n/a	0	n/a
DHA (22:6 n-3) (g)	n/a	n/a	0	n/a	0	n/a

Cholesterol (mg)	DGA	As low as possible	26	n/a	84	n/a
MINERALS						
Calcium (mg)	RDA	1000	1438	143.80%	1420	142.00%
Iron (mg)	RDA	27	21	77.78%	23	85.19%
Magnesium (mg)	RDA	350	457	130.57%	476	136.00%
Phosphorus (mg)	RDA	700	1820	260.00%	1450	207.14%
Potassium (mg)	AI	2900	3722	128.34%	3755	129.48%
Sodium (mg)	CDRR	2300	1676	72.87%	1427	62.04%
Zinc (mg)	RDA	11	13	118.18%	11	100.00%
Copper (mg)	RDA	1	2	200.00%	3	300.00%
Selenium (mcg)	RDA	60	88	146.67%	88	146.67%
VITAMINS						
Vitamin A, RAE (mcg)	RDA	750	903	120.40%	996	132.80%
Vitamin E, AT (mg)	RDA	15	12	80.00%	13	86.67%

Vitamin D (IU)	RDA	600	208	34.67%	377	62.83%
Vitamin C (mg)	RDA	85	143	168.24%	150	176.47%
Thiamin (mg)	RDA	1.4	2	142.86%	2	142.86%
Riboflavin (mg)	RDA	1.4	2	142.86%	2	142.86%
Niacin (mg)	RDA	18	20	111.11%	22	122.22%
Vitamin B_6 (mg)	RDA	1.9	2	105.26%	2	105.26%
Vitamin B_{12} (mcg)	RDA	2.6	4	153.85%	7	269.23%
Choline (mg)	AI	450	276	61.33%	413	91.78%
Vitamin K (mcg)	AI	90	174	193.33%	193	214.44%
Folate (mcg DFE[c])	RDA	600	773	128.83%	751	125.17%

[c] DFE = Dietary Folate Equivalent

Supplemental Table 12. 2600 kcal/day Ovo-Vegetarian and Models of a Healthy Vegetarian Dietary Pattern during Pregnancy[a]

2600	**Source of Goal used for Nutrient Level[b]**	**Nutritional Goals: Trimester 3 – Females 19-30**	**Healthy Vegetarian Dietary Pattern (HVDP)**	**Model 1: Ovo-Vegetarian (2600 kcal)**	**% of goal**	**Model 2: Vegan (2600 kcal)**	**% of goal**
ENERGY/MACRONUTRIENTS							
Calories (kcal)	DGA	2600	2604	2678	103.00%	2671	102.73%
Protein (g)	RDA	71	99	91	128.17%	91	128.71%
Protein (% kcal)	AMDR	10-35% of kcal	15.21%	13.59%	Within range	13.63%	Within range
Carbohydrate (g)	RDA	175	327	330	188.57%	332	189.71%
Carbohydrate (% kcal)	AMDR	45-65% of kcal	50.23%	49.29%	Within range	49.72%	Within range

[a] This table reflects nutrient values that do not include prenatal supplements.
[b] AI = Adequate Intake, AMDR = Acceptable Macronutrient Distribution Range, CDRR = Chronic Disease Risk Reduction, DGA = 2020-2025 Dietary Guidelines for Americans, RDA = Recommended Dietary Allowance

Fiber (g)	14 g/1000 kcal	36	41.0	42.0	116.67%	43.0	119.44%
Total Fat (g)	DGA	20-35% kcal	70.0	78.0	Within range	77.0	Within range
Total Fat (% kcal)	AMDR	20-35% of kcal	24.19%	26.21%	Within range	25.95%	Within range
Saturated Fat (g)	DGA	<10% kcal	13.0	13.0	Within limits	12.0	Within limits
Saturated Fat (% kcal)	DGA	<10% kcal	4.49%	4.37%	Within limit	4.04%	Within limit
Monounsaturated Fatty Acids (g)	n/a	n/a	25.0	27.0	n/a	27.0	n/a
Polyunsaturated Fatty Acids (g)	n/a	n/a	27.0	32.0	n/a	32.0	n/a
18:2 Linoleic acid (g)	AI	13	24.0	27.0	207.69%	27.0	207.69%

18:3 Linolenic acid (g)	AI	1.4	3.00	4.00	285.71%	4.00	285.71%
EPA (20:5 n-3) (g)	n/a	n/a	0.00	0.00	n/a	0.00	n/a
DHA (22:6 n-3) (g)	n/a	n/a	0.00	0.00	n/a	0.00	n/a
Cholesterol (mg)	DGA	As low as possible	106	84	n/a	4	n/a
MINERALS							
Calcium (mg)	RDA	1000	1498	1482	148.20%	1483	148.30%
Iron (mg)	RDA	27	23	25	92.59%	26	96.30%
Magnesium (mg)	RDA	350	496	522	149.14%	528	150.86%
Phosphorus (mg)	RDA	700	1966	1593	227.57%	1588	226.86%
Potassium (mg)	AI	2900	4060	411	141.76%	4121	142.10%
Sodium (mg)	CDRR	2300	1815	1558	67.74%	1551	67.43%
Zinc (mg)	RDA	11	15	13	118.18%	13	118.18%
Copper (mg)	RDA	1	2	3	300.00%	3	300.00%
Selenium (mcg)	RDA	60	102	96	160.00%	90	150.00%

VITAMINS							
Vitamin A, RAE (mcg)	RDA	750	1025	1086	144.80%	1054	140.53%
Vitamin E, AT (mg)	RDA	15	13.00	14.00	93.33%	14.00	93.33%
Vitamin D (IU)	RDA	600	230	380	63.33%	362	60.33%
Vitamin C (mg)	RDA	85	156	164	192.94%	164	192.94%
Thiamin (mg)	RDA	1.4	2.00	2.00	142.86%	2.0	142.86%
Riboflavin (mg)	RDA	1.4	2.00	2.00	142.86%	2.00	142.86%
Niacin (mg)	RDA	18	23.0	24.0	133.33%	24.0	133.33%
Vitamin B_6 (mg)	RDA	1.9	2.00	2.00	105.26%	2.00	105.26%
Vitamin B_{12} (mcg)	RDA	2.6	4.00	7.00	269.23%	7.00	269.23%
Choline (mg)	AI	450	357	438	97.33%	381	84.67%
Vitamin K (mcg)	AI	90	203	223	247.78%	223	247.78%
Folate (mcg DFE[c])	RDA	600	849	840	140.00%	901	150.17%

[c] DFE = Dietary Folate Equivalents

Supplemental Table 13. 2600 kcal/day Lacto-Vegetarian and Pescatarian Models of a Healthy Vegetarian Dietary Pattern during Pregnancy[a]

2600	**Source of Goal used for Nutrient Level[b]**	**Nutritional Goals: Trimester 3 – females 19-30**	**Model 3: Lacto-vegetarian (2600 kcal)**	**% of goal**	**Model 4: Pescatarian (2600 kcal)**	**% of goal**
ENERGY/MACRONUTRIENTS						
Calories (kcal)	DGA	2600	2597	99.89%	2618	100.69%
Protein (g)	RDA	71	99	139.12%	107	150.62%
Protein (% kcal)	AMDR	10-35% of kcal	15.25%	Within range	16.35%	Within range
Carbohydrate (g)	RDA	175	328	187.58%	319	182.17%

[a] This table reflects nutrient values that do not include prenatal supplements.
[b] AI= Adequate Intake, AMDR= Acceptable Macronutrient Distribution Range, CDRR= Chronic Disease Risk Reduction, DGA= 2020-2025 Dietary Guidelines for Americans, RDA= Recommended Dietary Allowance

Carbohydrate (% kcal)	AMDR	45-65% of kcal	50.52%	Within range	48.74%	Within range
Fiber (g)	14 g/1000 kcal	36	41.8	116.12%	40.8	113.41%
Total Fat (g)	DGA	20-35% kcal	68.6	Within range	70.9	Within range
Total Fat (% kcal)	AMDR	20-35% of kcal	23.77%	Within range	24.37%	Within range
Saturated Fat (g)	DGA	<10% kcal	12.3	Within limits	13.0	Within limits
Saturated Fat (% kcal)	DGA	<10% kcal	4.26%	Within limit	4.47%	Within limit
Monounsaturated Fatty Acids (g)	n/a	n/a	24.8	n/a	25.5	n/a
Polyunsaturated Fatty Acids (g)	n/a	n/a	26.8	n/a	27.2	n/a

18:2 Linoleic acid (g)	AI	13	23.7	181.98%	23.5	181.12%
18:3 Linolenic acid (g)	AI	1.4	3.05	217.89%	3.04	216.82%
EPA (20:5 n-3) (g)	n/a	n/a	0.00	n/a	0.09	n/a
DHA (22:6 n-3) (g)	n/a	n/a	0.00	n/a	0.20	n/a
Cholesterol (mg)	DGA	As low as possible	26	n/a	139	n/a
MINERALS						
Calcium (mg)	RDA	1000	1499	149.88%	1500	149.97%
Iron (mg)	RDA	27	23	85.44%	23	84.03%
Magnesium (mg)	RDA	350	502	143.45%	505	144.35%
Phosphorus (mg)	RDA	700	1960	280.04%	2052	293.16%
Potassium (mg)	AI	2900	4070	140.35%	4174	143.93%
Sodium (mg)	CDRR	2300	1807	78.57%	1869	81.26%
Zinc (mg)	RDA	11	14	131.74%	15	135.23%
Copper (mg)	RDA	1	2	220.04%	2	219.22%

Selenium (mcg)	RDA	60	96	160.07%	119	198.06%
VITAMINS						
Vitamin A, RAE (mcg)	RDA	750	993	132.39%	1036	138.12%
Vitamin E, AT (mg)	RDA	15	13.37	89.12%	13.65	90.98%
Vitamin D (IU)	RDA	600	212	35.34%	329	54.84%
Vitamin C (mg)	RDA	85	156	183.72%	156	184.04%
Thiamin (mg)	RDA	1.4	2.44	173.96%	2.40	171.10%
Riboflavin (mg)	RDA	1.4	2.02	144.31%	2.12	151.18%
Niacin (mg)	RDA	18	22.8	126.48%	24.1	134.16%
Vitamin B_6 (mg)	RDA	1.9	2.34	123.24%	2.46	129.37%
Vitamin B_{12} (mcg)	RDA	2.6	3.99	153.27%	5.70	219.07%
Choline (mg)	AI	450	300	66.61%	383	85.04%
Vitamin K (mcg)	AI	90	204	226.19%	203	225.77%
Folate (mcg DFE[c])	RDA	600	869	144.83%	833	138.83%

[c] DFE= Dietary Folate Equivalent