



Review Article

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# Managing the Nutritional Requirements of Vegetarian and Vegan Mothers During Pregnancy



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## Abstract

Vegan pregnant women have a lower-than-average rate of cesarean delivery, less postpartum depression, and lower neonatal and maternal mortality. Well-planned plant-based diets have been confirmed as safe during pregnancy and lactation, as well as conferring additional health advantages. However, vegan diets that are highly restricted in calories and nutrients may give birth to infants whose weights are significantly lower than expected, so it's important for physicians to know how to manage such pregnancies. Vegetarians and vegans have significantly lower BMIs, on average, and a lower risk of hypothyroidism, which are the most significant risk factors for Gestational Diabetes Mellitus. They also have a lower risk of pre-eclampsia and gallstone disease. Comorbidities such as chronic kidney disease and hypercholesterolemia can be effectively treated with a plant-based diet. Fear that the risk of the birth defect hypospadias was increased by following a vegetarian diet have proved unwarranted.

Protein intake of vegan women should be increased by 10% while pregnant, and they should be encouraged to consume a wide variety of plant-based foods. Adequate sources of Omega 3 fats, calcium, iodine, vitamins B12 and D must be ensured, and a multi-micronutrient supplement tablet containing the recommended daily allowance (RDA) of several vitamins and minerals is recommended. A plant-based diet offers significant advantages in reducing complications of pregnancy as well as treating comorbidities such as Type II diabetes. While attention to vitamin B12 and other nutrients, when indicated, is important, a vegan pregnancy is not very different from the more common pregnancies.

**Keywords:** Birth defects; Birthweight; Gestational diabetes; Lactation; Plant-based; Pre-eclampsia; Pregnancy; Pregnant; Vegan; Vegetarian

## Introduction

Although often framed in terms of lacking, vegan diets are actually rich in a wide variety of foods: grains, legumes (including soy and its derivatives), vegetables, fruits, nuts and seeds, vegetable fats, and herbs and spices [1,2]. The American Academy of Nutrition and Dietetics position statement on plant-based diets confirms their safety during pregnancy and lactation and that they may confer additional health advantages [1] Vegan pregnant women have a lower-than-average rate of cesarean delivery, less postpartum depression, and lower neonatal and maternal mortality, with no complications or negative outcomes that are higher than average [3-5]. Both maternal malnutrition and overnutrition are associated with subsequent diabetes in the offspring. Pregnancy represents a window of opportunity for health care providers to change dietary patterns toward habits that will be healthier for the individual now, as well as impacting the mother and child in the future [6]. A growing number of people are choosing to be vegetarians and vegans in the United States.

According to a survey conducted by Vegetarian Times there are about 7.3 million vegetarians in United States. Of those about 1 million are vegan [7]. These numbers are likely to rise especially with the increased availability of meat substitutes. It's important for the physician to know how to manage their pregnancies.

### Birthweight concerns for vegetarian mothers

Several studies have looked at the birthweight of infants born to vegetarian mothers. Five studies showed a lower birthweight in the children of vegetarian mothers [8-12]. However the result was significant in only one study. Conversely, birthweight and length were higher in children of vegetarian mothers in two studies. [13, 14].

Results of all these studies are affected by country, ethnicity, socioeconomic status, and other health related behaviors such as smoking and access to prenatal care [15,16]. This is a crucial issue also reflected in the different social patterns in rich, western

countries, in which vegan-vegetarian diets are often chosen in the quest for a healthier lifestyle, compared with low income countries, in which the nutritional deficits may be linked to forced limitations in the availability of food [17].

One study found that significantly higher birthweight (mean 99g) above that of non-vegetarians, and involved a community of Seventh-Day Adventists [14]. This is notable because, as a group, Seventh-day Adventists follow a healthy lifestyle. The difference in this study was therefore most likely related to diet.

Another study showed that the birthweight of children of vegan mothers is lower than that of the omnivorous mothers' children, but the values of this anthropometric parameter were all within the accepted range. No significant difference has emerged from the comparison for the length, cranial circumference and BMI at birth between the vegan group and the omnivorous group [18].

Vegan diets that are highly restricted in calories and nutrients, in contrast to well-planned vegan diets, give birth to infants whose weights are significantly lower than expected [12]. Concerns about vegan diets during pregnancy, breastfeeding, infancy, and childhood arose in the past [17,19,20], but this was due to the fact that although being categorized as "vegan", the investigated subjects were following highly restrictive diets, not respecting all the criteria required to define the diet as being well-planned.

### Risk of gestational diabetes

Observational studies show consistent evidence that increased BMI and hypothyroidism are the strongest risk factors for Gestational Diabetes Mellitus (GDM) [21]. Vegetarians and vegans have significantly lower BMIs on average. A study of American vegetarians and vegans found that vegetarians had a mean BMI of 25.7 and vegans a mean BMI of 23.6 [22]. A European study found the average BMI of vegetarians and vegans to be 23.3 and 22.4 respectively for men and 22.8 and 21.8 for women [23]. A study of German vegans found an average BMI of 22.3 [24]. While vegan diets are associated with lower body weight, which may protect against hypothyroidism, a lower risk of hypothyroidism among vegans exists even after controlling for BMI and potential demographic confounders. One study showed that following a vegan diet tended to be associated with a 22% reduced risk of hypothyroidism, although statistical significance was not quite attained [25].

A high intake of fiber during pregnancy also seems to be particularly beneficial in preventing GDM. Indeed, maternal diets characterized by low intakes of fiber and a high glycemic load seem to be associated with an increased risk of GDM. In particular, an increment of 10g/day in total fiber intake was found to be associated with a 26% risk reduction in GDM and an increment of 5g/day in cereal or fruit fiber intake was associated with a 23% or 26% reduction in GDM, respectively [26]. The vegetarian diet was also associated with a lower incidence of excessive gestational weight gain [27].

Higher intake of animal protein, in particular red meat, was significantly associated with a greater risk of GDM. Several major food sources of animal protein, such as red meat, were positively associated with the risk of GDM [28]. In particular, a meat-centered diet was associated with significantly higher GDM risk in parous and obese women [29]. By contrast, higher intake of vegetable protein, specifically nuts, was associated with a significantly lower risk. Substitution of vegetable protein for animal protein was associated with a lower risk of GDM [30].

### Risk of gallstones

The incidence rates of biliary sludge (a precursor to gallstones) and gallstones are up to 30% and 12%, respectively, during pregnancy and postpartum, and gallbladder disease is the most common non obstetrical cause of maternal hospitalization in the first year postpartum [31,32]. Prevention of gallstone disease is especially important during pregnancy, as cholecystectomy is problematic and medication can carry risks. In pregnancy, the incidence of cholesterol gallstones is increased by strong risk factors including obesity, serum leptin and extreme hypercholesterolemia. A plant-based diet has been shown to lower the risk of obesity, reduce leptin and eliminate cholesterol from the diet, thus reducing serum cholesterol and therefore gallstone risk during pregnancy without the risk that drug treatment may entail. [33].

### Risk of Pre-eclampsia

Vegans may have a lower risk of preeclampsia. The risk of preeclampsia in the general population is about 3%. However, in a study of 775 vegan pregnancies, only one case of preeclampsia was noted, [4] giving a rate of only about 0.1%. Other less specific studies have shown decreased risk with higher consumptions of fruits and vegetables. In a Norwegian study, women with high scores on a dietary pattern characterized by vegetables, plant foods, and vegetable oils, were at 28% decreased risk of preeclampsia for the highest tertile vs. the lowest tertile [34].

This could be related to the theory that the risk of preeclampsia is directly associated with a high consumption of fat and sugar and a low intake of fiber, since plant-based dietary patterns generally provide low amounts of fat and sugar and higher quantities of fiber [35]. One study showed that the highest quartile of soluble fiber intake reduced the risk of preeclampsia by 70% and insoluble fiber by 65% compared to the lowest quartile [36].

### Risk of birth defects

Early concerns were expressed about the birth defect hypospadias (a congenital malformation in which the opening of the penile urethra occurs on the ventral side of the penis) in association with vegetarian diets. However, this has turned out to be unwarranted according to a large study [37]. Other concerns raised over the use of soy phytoestrogens also seem to be unwarranted. According to one study, a higher intake of some phytoestrogens was associated with reduced risks of delivering

infants with hypospadias, even after adjustment for several covariates. This finding applied to overall intake of phytoestrogens as well as intake of specific phytoestrogens, so phytoestrogens may actually be protective of hypospadias [38].

Pregnant women following a well-planned plant-based diet, being naturally higher in folate, may have a reduced risk of an infant being born with spina bifida or anencephaly [39]. In contrast, a western diet (including high intake of meat) was shown to increase by around 2-fold the risk of offspring with orofacial cleft palate [40].

### Pregnant with chronic kidney disease

Using the most recent classification system, 3% of women of childbearing age are affected by Chronic Kidney Disease (CKD) [41, 42]. For these women, the risk of an adverse pregnancy rises very significantly, even in stage 1 [43]. Despite vast improvements in fetal outcomes, pregnancy in women with CKD is fraught with hazards; worsening renal function and complications such as preeclampsia and premature delivery are common [44].

During the pregnancy of a patient with CKD, the amount of protein in the diet must be balanced between the goal of diminishing hyperfiltration and increasing metabolic needs of pregnancy [45]. Due to the fact that pregnancy induces hyperfiltration, diets with restricted amount of protein should be beneficial in this group of patients [46,47]. Vegan or vegetarian supplemented low-protein diets in pregnant women with stages 3-5 CKD reduce the risk of small-for-gestational-age babies, without detrimental effects on kidney function or proteinuria in the mother [48].

CKD during pregnancy presents a clinical challenge, especially considering the paucity of therapeutic tools available in pregnant women. One study investigated the feasibility of supplemented vegetarian low-protein diets in pregnancy, as a "rescue treatment" for severe CKD and or proteinuria [46]. None of the 11 patients needed renal replacement therapy within the 6 months before delivery. No patient complained of side effects, nor developed hyperkalemia or hypercalcaemia. All babies were well at 1 month post delivery, and 7.5 years later [46]. A supplemented vegetarian low-protein diet (0.6-0.7g/kg per day) turned out to be sufficient for the maintenance of satisfactory nutritional status during the pregnancy and after delivery, even in breast-feeding women [49]. For pregnant women with focal segmental glomerulosclerosis, a study showed that a moderately protein restricted, keto analogue supplemented, plant-based diet helped control proteinuria [50]. Another study reviewed the results obtained over 15 years of treating pregnant women with CKD on moderately restricted plant-based low-protein diets. It confirms that such a diet is a safe option in the management of pregnant CKD patients [51]. A trend towards better preserved fetal growth was observed. These results indicate that the treatment of pregnant CKD women on moderately restricted plant-based low-protein diet is a safe option in the management of pregnant CKD.

### Clinical considerations during pregnancy and lactation on a vegan diet

Appropriately planned vegetarian, including vegan, diets are healthful, nutritionally adequate, and may provide health benefits for the prevention and treatment of certain diseases. These diets are appropriate for all stages of the life cycle, including during pregnancy and lactation [1]. Protein intakes should be increased by 10% in vegan pregnant and lactating women, compared with non-pregnant adult vegetarians. [2,52,53]. Additional servings of grains, protein-rich plant foods (legumes, soy milk, soy yogurt, tofu, tempeh, and meat analogs based on wheat or soy protein) and nuts and seeds should be consumed by vegan women during the second and third trimester of pregnancy and during breastfeeding to meet these increased protein requirements [53].

The patient should be advised to consume large amounts and a wide variety of plant foods, emphasizing the intake of whole or minimally processed foods: a vegan diet can be nutritionally adequate when meeting the calorie requirements from a variety of nutrient-dense foods, mainly unprocessed, belonging to all the plant food groups. It is recommended that the amount of vegetable fats be limited, as suggested by the Dietary Reference Intakes (DRIs), in order to limit excess calories and not displace more nutrient-dense foods. However, DHA plays an important role in pregnancy and lactation. Infants of vegetarian mothers appear to have lower cord and plasma DHA than do infants of nonvegetarians although the functional significance of this is not known [9,13]. Vegetable fats should therefore be chosen carefully, in order to consume good sources of omega-3 fatty acids such as walnuts, ground chia seeds and flax seeds (which can be converted to DHA) and monounsaturated oils, while avoiding trans fats and tropical oils (coconut, palm, and palm kernel oils), to emphasize the efficiency of the omega-3 metabolic pathway. DHA supplements made from microalgae are available and can be a supplement for patients when indicated. Note that during infancy and early childhood, fats should not be limited but should still be carefully chosen [2,53,54].

Adequate amounts of calcium should be consumed, and vitamin D status should be checked. Additional calcium can be obtained by increasing the intakes of calcium-rich foods from plant sources. Conversely, since a plant-based diet cannot provide adequate amounts of vitamin D, the recommendations for vitamin D are the same as for the general population [2,53,54]. Adequate amounts of vitamin B12 are essential, as deficiency increases the risk of neural tube defects in the infant [55]. The intake of a reliable source of vitamin B12 is fundamental to a well-planned vegetarian diet, as vitamin B12 status can be compromised, over time, in all vegetarian subjects who do not supplement it. [2,53,54] Since B12 deficiency can occur during pregnancy regardless of the type of diet, because of store depletion due to higher demands [56], the use of a specific vitamin B12 supplement represents the most reliable way or ensuring an adequate B12 status during vegan pregnancy

[57]. Increased caloric and nutrient intakes are recommended to meet the demands of the rapidly growing fetus and the increased physiological requirements of the mother, especially for folate, iron, iodine, and copper [58,59]. Although nutrient intakes should preferably come from a variety of food sources, it is possible that pregnant women and those of childbearing age won't meet their needs for some nutrients through diet alone [60,61]. As such, prenatal dietary supplements are generally recommended during pregnancy [62,63]. and were used by about 75% of pregnant women in a nationally representative US sample [60].

However, prenatal dietary supplements provide variable nutrient content and the number of nutrients included in dietary supplement formulations is not standard [62]. Concerns exist of excessive intakes of some nutrients during pregnancy, especially folic acid and vitamin A, [64,65] while low intake of iron and iodine in reproductive-aged US women has also been of concern [66]. Thus, ensuring that pregnant and reproductive-aged women have adequate, but not excessive, dietary intakes is crucial during this critical life stage [67].

A multimicronutrient supplement tablet containing the recommended daily allowance (RDA) for pregnancy of several vitamins and minerals: vitamin A, vitamin B1, vitamin B2, niacin, vitamin B6, vitamin B12, folic acid, vitamin C, vitamin D, vitamin E, iron, copper, selenium, and zinc, should be prescribed [68].

The patient should be questioned about their sources of iodine, such as iodized salt and seaweed. If these are lacking in their diet then a prenatal supplement containing iodine is important. One advantage of a plant-based diet is that it can prevent and treat comorbidities. When comorbidities are present, it is important to titrate any medications when initiating a plant-based diet as the effects of the plant-based diet becomes evident.

### Ensuring good quality breast milk

The breast milk of vegetarian women is similar in composition to that of nonvegetarians and is nutritionally adequate. Commercial infant formulas should be used if infants are not breastfed or are weaned before 1 year of age. Soy formula is the only option for non-breastfed vegan infants. Other preparations including regular soymilk, rice milk, and homemade formulas should not be used to replace breast milk or commercial infant formula [69]. The period of lactation is extremely important for growing patterns of infants and the effectiveness of breastfeeding depends on maternal nutritional status. A lack of macro- and micronutrient intake during lactation may lead to the reduction of micronutrients and energy content in breast milk that could potentially lead to severe illness in the breastfed infant [70].

Breast milk of vegan women following well-planned vegan diets including a reliable source of vitamin B12 provides adequate nutrition for their breastfed infants [53]. According to one study, 20% of study participants were classified as having low breast-milk vitamin B-12 concentrations (<310pmol/L), independent

of maternal diet pattern [57]. In this study, 85% of participants categorized as having low vitamin B-12 were taking vitamin B-12 supplements at doses in excess of the RDA, which suggests that more research is needed to determine breast-milk adequacy values [57]. Milk from breastfeeding vegan mothers provides adequate vitamin B12 in infants only if vegan mothers are supplementing with B12 sufficiently larger than the recommended amounts [57]. Given the safety of vitamin B12 supplements, [71] large amounts should ensure sufficiency.

Although containing 100% of the RDA for vitamin B12, common pre- and postnatal multivitamins have been negatively associated with low B12 concentration in breastmilk of vegan women, because only a fraction of the B12 they provide is absorbed [2,56]. Pregnant and lactating vegan mothers should be encouraged to take an individual B12, not multivitamin, supplement and to dissolve it under the tongue or chew it slowly in order to increase absorption [2,57].

Breast milk DHA is lower in vegans and lacto-ovo-vegetarians than in nonvegetarians [72,73]. Because of DHA's beneficial effects on gestational length, infant visual function, and neurodevelopment, pregnant and lactating vegetarians and vegans should choose the DHA precursor linolenic acid in their diet (ground flaxseed, ground chia seeds, walnuts, canola oil, soybean oil), food sources of DHA (foods fortified with DHA-rich microalgae) or use a microalgae-derived DHA supplement [74,75]. Supplementation with ALA, a DHA precursor, in pregnancy and lactation may not be sufficient to increase infant DHA levels or breast milk DHA concentration [76,77].

### Discussion

A plant-based diet offers significant advantages in reducing complications of pregnancy. It also provides a safe and effective treatment for comorbidities that are happening earlier in life such as Type II diabetes, extreme hypercholesterolemia, and auto-immune diseases such as hypo and hyperthyroidism, plus it helps prevent gallstones to which pregnant women are more susceptible. The American Academy of Nutrition and Dietetics position statement on plant-based diets confirms their safety during pregnancy and lactation, and that they may confer additional health advantages.

Supplementation with vitamin B12 is essential, since deficiency increases the risk of neural tube defects. Some vegan women resist vitamin B12 supplementation out of philosophical objections. They seem to want to show that a plant-based diet is sufficient by itself, and they misunderstand that since vitamin B12 is synthesized by soil bacteria, it is our modern hygiene practices (scrupulously washing our vegetables) that results in less Vitamin B12 being absorbed by those not consuming animal products. It is likely that if more women following a plant-based diet, as a group, ensured adequate vitamin B12 and iodine intake, their health advantages in pregnancy would be even greater than they already



are. However, while attention to vitamin B12 and other nutrients is important, a vegan pregnancy is not very different from the more common pregnancies, while conferring considerable benefits.

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