

DSOG Guideline Bulletin: Vegetarian and vegan diet during pregnancy and lactation

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Abstract

Vegetarian and vegan diets are becoming increasingly common among Danish women of reproductive age. We reviewed the available literature via PubMed and concluded that varied and well-balanced vegetarian and vegan diets are safe and sufficient during pregnancy and lactation, provided that dietary supplements for folate, vitamin B12, and vitamin D are taken regularly. Additionally, it is important to ensure adequate intake of calcium, protein, and iron. Protein requirements may be higher for vegetarians and especially for vegans, though evidence is limited regarding the recommendation for increased protein intake if the diet is exclusively plant-based. Routine blood tests are not recommended unless there has been insufficient supplementation leading up to or during pregnancy, or if symptoms suggest a deficiency. We found no evidence to support supplementation with docosahexaenoic acid (DHA). There is no indication of an increased risk of malformations for pregnant Danish women on a vegetarian or vegan diet compared to omnivores. The risk of delivering small for gestational age and low birthweight infants (<2500 grams) may be increased, but the evidence is conflicting and of poor quality. Vegetarian and vegan diets may offer benefits, such as a lower risk of excessive gestational weight gain and women consuming the lowest amounts of meat have a significantly lower risk of gestational diabetes. Vegans may face a lower risk of having large for gestational age infants. Vegetarian and vegan lifestyles are also compatible with breastfeeding, and provided women take the recommended supplements, there is no difference in the micronutrient content of the breast milk of vegetarian/vegan women compared to that of omnivores. Children of vegans and vegetarians with limited or no consumption of milk products or eggs are recommended to breastfeed or receive baby formula for at least the first two years of life.

Keywords: vegetarian; vegan; pregnancy; guideline

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Introduction

Vegetarian and vegan diets are increasingly popular among younger Danes, with estimates indicating that more than 10% of women 18-34 years are currently adopting such lifestyles (1). Vegetarians do not consume any form of meat or fish but may include dairy products and eggs in their diets. Vegans, on the other hand, avoid all animal products. Certain nutrients found in animal products may be more challenging to attain from vegetarian and vegan diets alone. During pregnancy, the demand for nearly all nutrients increases to varying degrees. To equip women and clinicians with the necessary information to mitigate potential risks, the Danish Society of Obstetricians and Gynecologists (DSOG) tasked a guideline group (the authors of this paper) with reviewing the evidence and developing these clinical recommendations.

Objectives

The objective of this paper is to review the current literature to determine whether pregnant and lactating women who follow vegetarian or vegan diets as opposed to those who consume meat, face a higher risk of pregnancy complications, nutritional deficiencies, or adverse outcomes for the fetus/infant.

Methods

Databases searched: Medline (PubMed)

Date of last search: 11th of January 2023.

Date of approval of the DSOG annual meeting: 20th of January 2024.

OCEBM levels of evidence (Oxford) were used to assess the strength of the evidence and formulate clinical recommendations. Search string: (pregnancy OR pregnant OR childbirth OR lactation OR gravidity OR gestation) AND (vegetarian OR vegan OR plant-based). MeSH terms did not identify additional studies. No restrictions were applied to the search criteria.

Results

The search yielded 598 articles. Two authors initially reviewed these articles by title and abstract, identifying 269 relevant articles for further full text review by the author group. We include 30 studies in our final recommendations, which reflects that there were recent review studies available.

The majority of the included studies were observational, which may not fully capture the potential hazards associated with vegetarian and vegan diets during pregnancy and lactation. This is because women following these diets might be more proactive in mitigating these hazards by taking appropriate vitamin and nutritional supplements.

Preterm birth

A systematic review (2) from 2020 which included three studies, along with one subsequent paper (3), found no significant difference in risk of preterm birth.

Birthweight and growth restriction

The evidence is very poor and heterogeneous, as reviewed by two systematic reviews in 2019 and 2020, identifying seven and eleven studies, respectively (2,4), with three additional studies published subsequently (3,5,6). Excluding evidence from Asian populations which carries a significant risk of bias due to social factors, there might be an increased risk of small for gestational age (SGA) without morbidity for offspring of women on vegetarian or vegan diets compared to women consuming meat. There is also a possible increased risk of low birthweight (<2500 grams) for offspring of women on a vegan diet (6).

Given the limited number of cases, the evidence should be interpreted with caution. We found no justification for recommending additional fetal ultrasound scans during pregnancy.

	Trying to conceive	1. trimester 2-9 weeks 10-12 weeks	2. trimester 13-27 weeks	3. trimester 28 week - birth	Breastfeeding 0-6 months
Folic acid	400 µg daily				
Iron*		40-50 mg daily			15 mg daily
Vitamin D*	25 µg daily				
Calcium		500 mg supplement daily, or 0.4L dairy product/plant based milk with added calcium, or 0.3L dairy product + 20g cheese (1 slice)			
Vitamin B12*	9 µg x 1 daily, or 1000 µg x 2-3 weekly §				
Caloric intake		" +100 kcal daily"	" +330 kcal daily"	" +530 kcal daily"	" +500 kcal daily"
Protein		" +1 g daily"	" +9 g daily"	" +28 g daily"	" +13 gr daily"
	All pregnant women / breastfeeding				
	All pregnant women / breastfeeding, but increased awareness for vegetarians/vegans				
	All pregnant women / breastfeeding, but the dose is increased for vegetarians/vegans				
	Only applies to vegetarians/vegans				
*	Blood tests can be considered in early pregnancy, but not routinely.				
§	If B12 supplementation is insufficient prior to getting pregnant, consider a blood test.				
	The first 1-2 µg of vitamin B12 are absorbed fully, but only 1% of the rest are absorbed passively.				
NB: Typical pregnancy supplements are insufficient in vitamin B12 for pregnant and lactating vegetarians/vegans.					

Table 1: Our recommendations for dietary supplements tailored to pregnant and lactating women adhering to vegetarian and vegan diets.

Fetal anomalies

A 2019 systematic review analyzing eight studies, found no significant increase in the risk of hypospadias associated with maternal diet (4).

The evidence linking orofacial clefts with diet was sparse and of poor quality, based solely on one study from India.

The same systematic review (4) identified two studies examining the relationship between neural tube defects (NTD) and diet. One study from India suggested an increased risk of NTDs in association with a vegetarian, whereas a Danish study found no significant association. In the Indian cohort, only 25% of women adhered to recommended supplement intake during pregnancy, compared to 91% in the Danish study.

A solitary study on trisomy 21 indicated no significant increased risk associated with vegetarian diets, though it highlighted a

potential for false-positive screenings due to elevated beta-hCG levels in vegetarians (7).

Excessive maternal weight gain

A 2020 systematic review (2) identified three studies addressing maternal weight gain, two of which conducted in Indonesia and deemed of low quality. A study from the USA, which included 1,388 women and assessed weight at 11.7 and 29.2 weeks of gestation, found that a vegetarian diet was associated with a significantly lower risk of excessive weight gain. Since the publication of this review, two additional studies have been released. One study in Israel involving 1,419 mothers found that both vegetarian and vegan diets were associated with a lower risk of excessive weight gain (3). Another study from the USA, involving 1,948 women showed that a fully vegetarian diet was associated with a lower, though not statistically significant, risk (5).

Gestational Diabetes Mellitus (GDM)

A retrospective study from Israel showed a lower risk of GDM with vegan and vegetarian diet though not significantly (3). Similarly in a subsequent study from the USA, a full-vegetarian diet had a lower GDM risk, which was also not significant (5).

In the Nurses' Health Study II, which included 20,707 pregnancies, the risk of GDM was examined concerning a plant-based diet showing a significantly lower risk for each 10-point increment on the plant-based diet index (8).

Preeclampsia

There was very limited evidence regarding this outcome. A single study from the USA involving 1,948 women did not show a significant association (5). Indirect evidence from non-pregnant participants in a meta-analysis of randomized trials showed a significant decline in both systolic and diastolic blood pressure in the groups randomized to vegetarian or vegan diets compared to omnivore diets (6).

Vitamin B12

Before reporting the evidence, it is important to highlight the challenges associated with interpreting blood tests for vitamin B12 (cobalamin) during pregnancy. There is no consensus on a normal reference interval and it's known that pregnant women experience a natural but false decline in vitamin B12 levels, attributed to lower levels of the binding protein Haptocorrin (10). Consequently, routine blood test monitoring of vegetarians and vegans is not recommended unless special circumstances, such as lack of supplementation prior to pregnancy, are present.

Additionally, the absorption of B12 depends on the intrinsic factor produced in the stomach, limiting absorption to only about 1-2 µgrams passively, with only about 1% of the

ingested supplement reaching the bloodstream (11). Since vitamin B12 supplementation is considered safe even in high doses, it can be recommended without prior blood test screening (12).

Pregnant women following a vegetarian diet and not taking vitamin B12 supplements are at an increased risk of biochemical deficiency (13–15). However, when pregnant vegetarians take B12-supplements, no discernible difference is observed in maternal blood tests from early to late pregnancy or in umbilical cord blood tests (15). Numerous case reports document infants with neurological symptoms due to vitamin B12 deficiency born to vegetarian/vegan mothers (16). Nonetheless, the treatment approach almost always involves some form of vitamin B12 supplementation, indicating that the deficiency could have been prevented if the mother had been taking supplements initially.

Vitamin D

Sunlight serves as the primary source of vitamin D. In Denmark, food intake contributes only about 2-3 µgrams, covering 10-20% of the recommended dose. Consequently, the Danish Health Authority recommends that all pregnant women take a daily 10 µgram vitamin D supplement (17).

Literature on the vitamin D status of pregnant vegetarians and vegans is limited. We will mention one study here: a Danish cohort study found that only 39% of vegans and 51% of omnivores reached the recommended vitamin D dose, with vegans having significantly lower intake from food alone (7). Indirect evidence suggests that non-pregnant vegans experience lower serum vitamin D levels during winter, although accounting for the effects of dietary supplements poses challenges (18).

Pre-pregnancy weight	Trimester		
	1.	2.	3.
<50 kg	42 g	50 g	69 g
50-60 kg	51 g	59 g	78 g
61-70 kg	59 g	67 g	86 g
71-80 kg	67 g	75 g	94 g
81-90 kg	76 g	84 g	103 g
91-100 kg	84 g	92 g	111 g
101-110 kg	92 g	100 g	119 g

Table 2: Recommended protein intake in grams during pregnancy based on pre-pregnancy weight categories. The calculations were derived from the Nordic Nutrition Recommendations issued in 2023.

Anemia and ferritin

A single observational study conducted in Israel, with blood tests taken immediately before birth and from the umbilical cord, found no differences in hemoglobin and ferritin levels between omnivores, vegetarians, and vegans. Additionally, there was no significant difference observed in maternal or neonatal anemia. Notably, the authors did not account for iron supplementation (15). Indirect evidence from a 2018 review of 13 observational studies involving non-pregnant women suggests that vegetarians have a higher prevalence of anemia (17).

Folic acid

Folic acid is abundant in plants. A solitary study from Germany indicated that vegetarians have a significantly lower risk of folic acid deficiency (20).

Fatty acids

Humans rely on omega-3 and omega-6 long-chain polyunsaturated fatty acids from their diet. While plant oils provide sufficient quantities of omega-6 fatty acids, obtaining enough omega-3 fatty acids can be challenging for vegetarians and vegans. Two essential omega-3 fatty acids, eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA), are primarily found in fish and algae – but can be partially produced by the body through conversion

from another essential omega-3 fatty acid, alpha-linolenic acid (ALA), found in plants. Two studies compared the concentration of these fatty acids in umbilical cord blood from neonates born to mothers following vegetarian versus omnivore diets. DHA levels were significantly lower in neonates born to vegetarian mothers in both studies (21,22). However, DHA supplementation during pregnancy has not demonstrated any beneficial effects on offspring visual and cognitive outcomes (23).

Protein

Pregnant women experience an increased dietary need for protein, particularly in the third trimester. Plant protein sources generally have a lower absorption rate compared to animal protein sources. However, the Nordic Nutrition Recommendations from 2023 do not specify whether pregnant vegetarians should increase their protein intake beyond that of omnivores (24).

In a Danish observational study conducted on a cohort from 1996-2002, vegans (n=18) had an average protein intake of 10.4% of total energy intake, lower than that of vegetarians (n=183, 13.3%) and omnivores (n=65,872, 15.4%). The authors suggest that the lower protein intake among vegans might be associated with the lower birth weight of their offspring (-240 g, 95%CI -450 to -30) (7).

Indirect evidence from Danish and Norwegian mothers, regardless of dietary preferences,

indicates that lower protein intake is significantly correlated with lower birth weight (25).

Our protein intake recommendations are based on the Nordic Nutrition Recommendations of 2023 (24) and are simplified in table 2.

Breastfeeding

Exclusive breastfeeding for the first 6 months of an infant's life is recommended by both the Danish Health Authority and the World Health Organization due to the high nutritional value and health promoting effects of breast milk (17,26). Infants, born to vegetarian and vegan mothers who consume limited or no dairy or egg products, are recommended to be breastfed for at least two years (27).

Vitamin B12 was found in similar concentrations in the breast milk of vegetarians, vegans, and omnivores in three out of four studies. The only study that reported lower concentrations of vitamin B12 in the breast milk of vegetarians noted that none of the participants took B12 supplements (28–31).

Overall, studies have shown that the breast milk of vegetarians and vegans is of comparable quality to that of omnivores (29,31). The nutritional value was so similar that breast milk from vegetarians and vegans

could be donated to milk banks (29). It should be noted that vegans (44.8%) and vegetarians (26.3%) were more likely to take vitamin supplements than omnivores (3.9%) (31).

Vegans and to some extent vegetarians had higher concentrations of unsaturated fatty acids and a greater total amount of omega-3 fatty acids in breast milk. On the other hand, breast milk from omnivores contained higher concentrations of saturated fatty acids and trans-unsaturated fatty acids, which in high amounts can have detrimental health effects (32).

Conclusions

We conclude that varied and well-balanced vegetarian and vegan diets are safe and adequate during pregnancy and lactation, provided that dietary supplements for folate, B12, and D-vitamins are taken consistently. Additionally, attention must be given to ensuring sufficient intake of calcium, protein, and iron intake as outlined in Table 1. The current evidence is limited and predominantly of low quality; thus, more research focused on Western populations is essential to offer improved guidance for pregnant vegetarians and vegans.

The full guideline in Danish can be read at the DSOG webpage: www.dsog.dk/obstetrik

TABLE OF SUMMARY OF EVIDENCE

Summary of evidence	Level of evidence
Vegetarian and vegan diet in pregnancy probably does not affect risk of preterm birth	2a
Vegetarian diet in pregnancy in women of western origin are probably not at greater risk of low birthweight under 2500 grams	2a
Vegan diet in pregnancy in women of Danish origins may have increased risk of low birthweight under 2500 grams	3a
Vegetarian diet in pregnancy in women of Asian origins probably have increased risk of low birthweight under 2500 grams	2a
Vegetarian and vegan diet in pregnancy probably have increased risk of small for gestational age (SGA), in particular for women of Asian origin	2b

Vegan diet in pregnancy may have lower risk of large for gestational age (LGA)	3a
Vegetarian diet in pregnancy may have increased risk of falsely elevated trisomy 21 risk, but only in the case of low vitamin B12 due to the effect on b-hCG	3a
Vegetarian and vegan diet in pregnancy where women take the recommended vitamin supplements possibly does not affect risk of fetal anomalies	3b
Vegetarian and vegan diet in pregnancy probably has lower risk of excessive weight gain during pregnancy	2b
Plant based diets in pregnancy probably lowers the risk of gestational diabetes mellitus (GDM)	2b
Plant based diets in pregnancy has no certain effect on risk of pre-eclampsia	4
Vegetarian diets in a non-pregnant population lowers blood pressures	1a
Vegetarian and vegan diets in pregnancy probably have a higher risk of resulting in vitamin B12 deficiency if the women do not take supplements	2b
Vegetarian and vegan diets in pregnancy may have a higher risk of resulting in vitamin D deficiency if women do not take supplements, but only vegans may have a slightly increased risk of deficiency despite taking supplements	3a
Vegetarian and vegan diets in pregnancy probably results in similar hemoglobin, ferritin, vitamin B12, and folic acid concentrations in umbilical cord blood compared to omnivores	2b
Vegetarian and vegan diets in pregnancy probably results in similar levels of serum ferritin	2b
Vegetarian and vegan diets possibly do not affect risk of anemia	3a
Vegetarian diet in non-pregnant women may result in a higher prevalence of iron deficiency and anemia	3a
Vegetarian and vegan diet in pregnancy probably have a lower risk of folic acid deficiency	2b
Vegetarian diet in pregnancy may result in lower concentrations of docosahexaenoic acid (DHA) in umbilical cord blood	3b
Vegetarian diet in pregnancy may result in higher concentrations of docosapentaenoic acid (DPA) in umbilical cord blood	3b
DHA-supplementation in pregnancy may not have any beneficial effects on the visual and cognitive outcomes in offspring	3b
Vegetarian and vegan diet in pregnancy may result in lower protein intake and there may be an association between lower protein intake and low birthweight under 2500 grams	3a
Vegetarian and vegan diet during lactation in women that take supplements probably results in breast milk of similar nutritional value	2b
Vegetarian and vegan diet during lactation in women that <i>do not</i> take supplements probably results in breast milk of poorer nutritional value	2b
All forms of diet probably results in low vitamin B12 levels in breast milk of just under 20% of all lactating women (a single study)	2b
Vegetarian and vegan diet during lactation in women that take supplements probably results in breast milk that can be donated to milk banks	2a

Vegetarian and vegan diet in lactating women that <i>do not</i> take B12 supplements probably increases risk of maternal and neonatal malnutrition and associated disorders	2c
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Oxford centre for evidence-based medicine (CEBM) levels of evidence. Comparisons are to an omnivore diet.

TABLE OF CLINICAL RECOMMENDATIONS

Recommendations	Grade of Recommendation
Vegetarian and vegan diets, that are well-balanced and include extra supplements, are evaluated to be safe during pregnancy and lactation	B
Vitamin B12 supplementation can be considered for pregnant and lactating vegetarians and vegans	C
Vitamin D supplementation can be considered for pregnant and lactating vegetarians and vegans	D
Awareness of sufficient protein intake can be considered for pregnant and lactating vegetarians and vegans	D
Awareness of sufficient iron supplementation can be considered for pregnant and lactating vegetarians and vegans	D
Routine fetal ultrasound in late pregnancy to ensure sufficient fetal growth is not necessary for pregnant and lactating vegetarians and vegans	D
Routine screening for serum vitamin B12, D, and iron, are not necessary if pregnant and lactating vegetarians and vegans take supplements, but are recommended if the patient's history might indicate deficiency	C
Routine DHA (omega 3 fatty acid) supplementation during pregnancy or lactation is not endorsed	C
Women who recently prior to pregnancy changed their diet to vegetarian or vegan can consider to seek advice from clinical dieticians with special interest for vegetarian/vegan diets.	√

Oxford centre for evidence-based medicine (CEBM) grades of recommendation

GDM: Gestational Diabetes Mellitus

NTD: Neural Tube Defects

b-hCG: beta-human chorionic gonadotropin

DSOG: Danish Society of Obstetricians and Gynecologists

Conflict of interest: PBA, HH, and SM are vegetarians. TB is a vegan and works for the Danish Vegetarian Association. TT has previously been an omnivore, vegetarian, vegan and is currently pescatarian. All other authors are omnivores and report no other conflicts of interest.

Abbreviations:

MeSH: Medical Subject Headings

DHA: Docosahexaenoic acid

EPA: Eicosapentaenoic acid

CEBM: The Centre for Evidence-Based Medicine

SGA: Small for Gestational Age

LGA: Large for Gestational Age

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