Maternal nutrition in pregnancy, of importance in The Netherlands?

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**Abstract**

Maternal nutrition in pregnancy is increasingly emphasized and several recommendations are given to mothers. In this review, the evidence on which such recommendations given in The Netherlands are based is collected. In well-nourished populations the evidence is generally not sufficient and results are relatively poor. Aside from the benefits of quitting smoking, alcohol and substance abuse, the only evidence-based nutritional recommendation in The Netherlands is the periconceptional use of folic acid in preventing neural tube defects in the fetus. However, only approximately a third of all pregnant Dutch women actually do take folic acid. This implies that other strategies need to be explored so as to be able to reach more of these women. In addition, there is a need for more high quality research on the health benefits of nutrition in well-nourished populations in pregnancy, both for mother and child. In developing countries, the health benefits of supplementing maternal diet in undernourished or vitamin deficient women are irrefutable.
Introduction

Many recommendations are usually given about nutrition in pregnancy because of its assumed health benefits for the mother and her unborn child. In The Netherlands, approximately 200,000 pregnancies occur annually. Owing to high standards of reproductive health, most of these pregnancies are planned. Also, since pregnancy has a profound impact on a woman’s body and life, women are generally eager to seek information on different topics, including nutrition. Apart from scientific evidence on which such information is based, personal choices are also masked by cultural beliefs and traditions. This article describes the nutrition-related recommendations given in pregnancy in The Netherlands and explores how evidence-based they are.

Material and methods

To assess the nutrition-related recommendations that are given in pregnancy to well-nourished women, a MEDLINE (1966 onwards) and an EMBASE (1980 onwards) search was performed using MeSH (or similar) terms ‘pregnancy and lifestyle’, ‘nutrition and pregnancy’ and diet’ in general and specifically in The Netherlands. Professional organizations, public information organizations and some other interest groups were approached to provide pregnancy-related information that is usually offered to the public. Also, books related to this topic and conference abstracts were considered, and enquiries were made to pregnancy-orientated organizations.

To investigate how evidence-based recommendations during pregnancy are and how they affect nutrition, an author-based search was performed using the Cochrane Library (issues 2000–2006), MEDLINE (1966 onwards) and EMBASE (1980 onwards) using the MeSH (or similar) terms ‘pregnancy and lifestyle’, ‘nutrition and pregnancy’ and ‘diet’ in general and more specifically in The Netherlands. Additionally, studies were considered from reference lists and review articles, and the coordinators of such studies were contacted via the internet.

Since the situation of food-insecure populations is completely different from the Dutch situation and research results from studies carried out in women with nutritional deficiency of specific nutrients are not applicable to well-nourished pregnant women, such as the Dutch, a selection was made.

Randomized controlled trials (RCT’s) are considered the highest level of evidence. To limit the large number of studies on this topic, only reviews of RCT’s or RCT’s themselves, comparing different diets or supplementing nutrients in well-nourished populations comparable to the Dutch situation, were selected. If no RCT’s were available, prospective observational studies were taken into account.
Results

Midwives or general practitioners in 80% of all pregnancies provide antenatal care during pregnancy. Obstetricians supervise approximately 20% of pregnancies and 50% of deliveries. Nearly all women in The Netherlands seek medical attention during pregnancy and receive information on nutrition from professionals during antenatal checks and leaflets that are given out – these are provided by the Royal Dutch Organization of Midwifery (KNOV), the Dutch College of Obstetrics and Gynecology (NVOG), the Dutch Federation of General Practitioners (NHG) and National Federation of General Practitioners (LVH), in close collaboration with health insurance companies and the Health Inspectorate.

Other organizations and interest groups also provide information on nutrition and such information is sometimes conflicting, for example, the issue for/against ‘vitamin D supplementation’ by the Dutch Dairy Association (NZO), the Netherlands Nutrition Centre Foundation and the Health Counsel.

Aside from the above-mentioned sources of information and the internet, many women receive additional information from their family members (sisters, mothers), neighbours and peers. Ethnic minority groups in particular, rely more on information that appeal to their culture.

Some books, such as ‘Zwanger tussen twee culturen’ by Aya Crebas and ‘Een kind op komst in kleurrijk Nederland’ by Fuusje de Graaff, have documented some alternative information women make use of and the shortcomings of some ‘official’ professional information given to the general public, which does not address the needs of specific ethnic minorities (1,2).

The general recommendations are as follows: all pregnant women should eat healthy frequent meals, with an energy surplus of 1250 kJ daily; they should consume more dairy products (but avoid raw milk and raw meat products); also, they should avoid handling cat deposits, gardening without gloves and cut down on their liver intake, smoking, alcohol and drug use. Folic acid supplementation is advised until a gestational age of 10 weeks.

Nutritional advice in pregnancy

A review by Reifsnider showed that the information and advice on nutrition during pregnancy was last revised 10 years ago (3). The reasons for this remain uncertain. Only one Cochrane review was conducted in 2000 to assess ‘the effect of nutritional advice in pregnancy on gestational weight gain and the outcome of pregnancy’ (4). The reviewer concluded that “nutritional advice appears to be effective in increasing a pregnant women’s energy and protein intakes”, but the implications for fetal, infant and maternal health cannot be judged from the available trials. Although several differences were reported, the difference between cases and controls for protein intake was not significant, and the number of case studies reviewed per outcome measured was very small. Another overview by Villar showed very few valuable interventions for specific outcomes. Such interventions are the use of iron supplements in anemia and folic acid supplementation in the prevention of neural tube defects (5).
Energy intake
Varied and sometimes contrasting advice is given by professionals (and non-professionals) on energy intake in pregnancy. During pregnancy, metabolic changes take place but several studies show an immense variability in these metabolic changes. Data from cross-sectional studies on this issue are often conflicting (6). According to Kopp-Hoolihan, the estimated extra energy requirement during a full-term pregnancy is believed to be approximately 335 MJ and only 15% of this is attributable to the energy deposited in fetal tissues and the products of conception; the rest of the energy is accounted for by the increased rate of metabolism (150 MJ) and the energy deposited as fat (2–5 kg) by the mother (130 MJ) (7). The precise mechanism in the change in energy metabolism is not completely understood.

Different strategies are used by well-nourished women to meet the additional demands and the combination of strategies is not wholly predictable from prepregnant indices. For this reason, a single recommendation for increased energy intake in all pregnant women is not justified. Other research supports this conclusion (8); there is no simple relationship between the extra energy needs in pregnancy and the extra energy intake advised, and this does not justify a fundamental and universal advice for all well-nourished pregnant women.

Protein intake
In 2002, Dugglebly showed that certain metabolic differences reflected the various abilities of individual women to adapt to pregnancy and conserve nitrogen (9). The mother’s ability to nourish her baby is influenced by her body composition and her rate of protein turnover. Thus, dietary intake does not adequately characterize or influence this ability (10). A Cochrane review on balanced protein/energy supplementation supports the idea that balanced energy/protein supplementation is associated with a modest increase in maternal weight gain and fetal growth, and supplementation suggests a reduction of both stillbirth and neonatal death rates (11). However, this evidence is not conclusive. There is no difference in the effect on fetal growth and maternal weight between well-nourished and undernourished women.

Folic acid
Based on studies by Czeizel and Jugglery, Dutch women are advised to take folic acid 0.5 mg OD preconceptionally and in the first 10 weeks of their pregnancy, in order to prevent neural tube defects (NTD) (12-17). More recent studies suggest that the preventive effect of folic acid is not limited to the prevention of NTD; when used for a longer duration it actually helps prevent spontaneous abortions and congenital malformations, such as cleft lip and palate, cardiac defects, urinary tract defects and limb reductions (18-21).

In 1995, a national public health campaign was organized to inform healthcare providers and the general public on the benefits derived from folic acid use. This greatly increased awareness over the next 5 years (22). Although approximately 70% of all women wishing to conceive were informed, not more then 36% actually used folic acid as prescribed. A Dutch
study showed that apart from international risk factors – young age and low education – and national risk factors – ‘getting pregnant sooner than expected’, ‘unawareness’ and ‘hearing too late of the importance of taking folic acid’ – the no-use of folic acid was for many a deliberate decision; the women simply disliked using medication during pregnancy (23).

**Iron**

Pregnancy requires approximately 1000 mg of total body iron, hence pregnant women are advised to eat iron-rich diets consisting of green vegetables, meat and whole grain products. The hemoglobin levels in pregnancy are lower due to hemodilution. Only severe anaemia poses a threat to mother and child.

Iron supplementation in nonanemic women during pregnancy increases the hemoglobin levels after birth, but the overall effect of iron supplementation remains unclear (24,25). In The Netherlands, anemia was diagnosed in 1-4% of the 160,000 women who visited their midwives for the first time in 2003. Iron supplementation was effective.

**Micronutrients**

Haider found no advantage supplementing multiple micronutrients (zinc, copper, selenium and magnesium) above iron and folate supplementation (26). However, many scientists have great expectations of magnesium and zinc. Magnesium may prevent preterm birth, low birth weight and preeclampsia, but a Cochrane review on magnesium stated there is not enough high-quality evidence to show that dietary magnesium supplementation during pregnancy is beneficial (27). Similarly, in many studies it was suggested that zinc may prevent cleft palate syndrome, accelerated fetal bone growth and stimulated neurobehavioral development and breastfeeding, but a Cochrane review on zinc could not clarify the protective effect of zinc supplementation (28-32).

**Vitamin A**

Vitamin A is an essential micronutrient whose role in visual function is well known. In regions where maternal vitamin A deficiency is widely prevalent, weekly doses of vitamin A (7000 µg retinol equivalents) or 42 mg carotene b lowered maternal mortality by 40 and 49%, respectively (33). Maternal vitamin A deficiency increased neonatal mortality and the transmission rate of HIV. Supplementation was believed to improve changes as far as transmission of HIV is concerned, but later studies showed a higher transmission rate of HIV in vitamin A-supplemented pregnant women (34-36).

In The Netherlands, there were no existing data on maternal deficiency and it seems highly unlikely that maternal vitamin A deficiency exists. Therefore, no reason exists to prescribe vitamin A supplements (37). In high doses, vitamin A is considered teratogenic, and for that reason the recommendation exists not to exceed one portion of liver products daily (38).
Vitamin B6
Except for the suggestion that vitamin B6 supplementation may protect against dental decay, sufficient evidence was not found to detect the clinical benefit of vitamin B6 supplementation (39).

Vitamin C
Data supporting its benefit during pregnancy are rather few. Some evidence suggests that it may even increase preterm births (40).

Vitamin D
There are few data on vitamin D consumption and the status of pregnant Dutch women. However, some case reports illustrated that hypovitaminosis occurred among women who wear veils and vegans. Quite recently, alarming data were published by Wielders wherein a severe vitamin D deficiency was detected among immigrant pregnant women of non-Western origin (in 55% of the mothers) and their newborns (in 54% of the newborns) (41). In nonmigrant populations, the figures were much lower - 5% for the mothers and 6% for the newborns. In 2002, the Health Council of The Netherlands published a report on a changing food consumption pattern. Although no specific information was collected on pregnant women, the Council advised pregnant and lactating women to take additional vitamin D. Before publication of this report, general practitioners considered the intake of extra vitamin D by pregnant and breast-feeding women unnecessary and not evidence based if these women were regularly outside with at least their face and hands uncovered (42,43). A Cochrane review supports this point of view, “there is not enough evidence to evaluate the effects of vitamin D supplementation during pregnancy” (44). However, one exception based on Wielders’ study is that vitamin D should be supplemented to women who wear veils and vegans during pregnancy (41,44).

Vitamin E
Data supporting the benefit of vitamin E supplementation during pregnancy are few (45).

Calcium/dairy products
Calcium is needed during pregnancy and lactation; 25–30 g of this calcium is transferred to the fetal skeleton by the end of pregnancy, most of which is transferred during the third trimester. Calcium supplementation is believed to have many favorable effects; preventing preeclampsia in high-risk pregnancies, increasing birth weight, lowering blood pressure in the offspring and reducing or preventing maternal bone absorption in pregnancy and lactation. If calcium reduces maternal bone resorption, the clinical importance of this reduction is not clear (46,47). Atallah performed a systematic review and concluded that “calcium supplementation appears to be beneficial for women at high risk of gestational hypertension and in communities with...
low dietary calcium intake” (48). The blood pressure lowering effects and possible prevention of preeclampsia seem promising.

**Raw meat**

Although the risk of contacting toxoplasmosis infection by eating raw meat is low, toxoplasmosis in pregnancy leads to fetal infection in 33% of cases. Approximately 75% of congenitally infected newborns are asymptotic, but sequelae might become apparent later in life. Severe forms of congenital toxoplasmosis do occur in 10% of cases (49). Eskild’s review in 1996 concluded that “sufficient scientific evidence is not yet available to propose screening for toxoplasmosis in pregnant women, and efforts should be made to provide such knowledge” (50). A Cochrane review from Peyron in 2000 and from Eskild in 2003 reaffirmed this conclusion (51,52). Apart from screening, the efficacy of treatment is also questionable. In The Netherlands, the primary focus is on prevention. Pregnant women are advised to wash vegetables thoroughly before consumption, to avoid raw meat and avoid handling cat deposits and working in the garden with ungloved hands. In 1980, Conijn-van Spaendonck found a seroconversion of 0.16% during pregnancy. A total of 27,900 women were screened during pregnancy and given the above-mentioned advice. The separate effect of screening and the advice could not be assessed (53).

**Raw cheese**

Listeriosis is a zoonosis transmitted by milk, cheese, meat, fish and poultry to humans. Soft cheese made from raw milk is particularly notorious for transmitting *Listeria*. If a woman becomes infected, it could predispose to abortions, stillbirth or a neonatal infection. This is very rare in The Netherlands and the incidence of *Listeria* in cattle, poultry and fish is very low. It took 20 years to collect 207 cases of *Listeria* meningitis in The Netherlands. The mean annual incidence decreased from 0.12 in 1981–1990 to 0.07 per 100,000 population in 1991–1995 (54). The latest data from The Netherlands show an incidence of 1.3 neonatal infections per 100,000 liveborns. Data from the ZOBAS study, a Dutch study exploring which evidence-based research should be carried out in case of stillbirth, shows that listeriosis is very rare; one in 300 stillborn babies was detected (Korteweg F, Pers. Comm. 2005). In The Netherlands, pregnant women are advised not to eat raw milk products.

**Fish**

Fish consumption during pregnancy is advocated because of the fatty acids, in particular the docosahexaenoic acid, and the latter’s assumed positive effect on fetal brain development. Recently, the ALSPAC study recorded beneficial effects on child development with maternal seafood intakes of more than 340 g per week (55).
Consumption of fish has also been related to a higher birth weight, lower risk of preeclampsia and lower risk of preterm birth (5). Olafsditter showed an increase in birth weight of babies of mothers consuming cod liver oil in the first trimester but because subjects and controls were not comparable it is difficult to interpret these data (56).

Since mercury accumulates during pregnancy in the unborn, methyl mercury poisoning in pregnancy leading to Minamata disease is one of the less favorable effects of high fish consumption in heavily polluted fishing grounds. Prenatal exposure to much lower doses has been linked to subtle learning delays and alterations of the autonomic nervous system. The NHANES study in the United States showed that 5.66% of women had too high mercury levels (57). There are no data from The Netherlands on fish consumption and mercury levels in pregnant women and babies. The evidence for increasing fish consumption during pregnancy is too weak. One Cochrane review on marine oil consumption to prevent preeclampsia and preterm delivery advises the use of large RCT’s to resolve the effects (58).

Smoking, alcohol & substance abuse in pregnancy
The devastating effects of smoking, alcohol and substance abuse in pregnancy are well known. Smoking increases the incidence of infertility, spontaneous abortions, premature placental abruption, premature birth, sudden infant death syndrome and low birth weight. Alcohol, and particularly binge drinking, increases the incidence of spontaneous abortions and may cause the fetal alcohol syndrome (59). Substance abuse may cause the neonatal abstinence syndrome, transmission of blood-borne diseases, preterm delivery, placental abruption and low birth weight (60). Regarding smoking, in 1994 Adriaanse found a decrease in the percentage of smokers; in the beginning of pregnancy 52% smoked and 36% smoked late in pregnancy (61). Regarding drinking, the ABCD study shows lowest alcohol intake during the first 3 months of pregnancy. Some 19.5% took less than one unit a day in the week before the interview. However, in particular, Dutch, well-educated women aged from 30–39 years are more used to continue to take alcohol during their pregnancy. Recently, the National Health Council advised women who want to become pregnant, or are pregnant, to abstain from alcohol completely (62). Regarding substance abuse, it is not exactly known how many pregnant women are drug addicted.

In general, current strategies to motivate women to stop smoking, drinking and substance abuse are insufficient. Taking all the studies on this topic into account is beyond the scope of this review.
Expert commentary

A longitudinal study from 1987–1990 in The Netherlands concluded that daily dietary needs of iron, selenium, vitamin A and copper in pregnancy were not being met (63). From the ALSPAC study in southwest England and a Finnish study it is known that the iron intake during pregnancy is low. Some 22.5% of the pregnant English women studied before 18 weeks’ gestational age, and 43% at 32 weeks, were taking iron supplements (64-68).

Data from other Western European countries and the USA show similar consumption levels below recommended standards for vitamin D, folate, calcium, magnesium, zinc, iron and fibers (69-71). Even hypovitaminosis D was diagnosed by Nesby-O’Dell in 2002 in 42.4% of African–American and 4.2% of Caucasian pregnant women (72).

In 2002, The Health Council of the Netherlands reported that the general population ate less fat, but also fewer fruits and vegetables. No specific information was collected about pregnant women (73). Thus, data available on maternal nutrition in The Netherlands are limited. However, besides this need to interpret the evidence vis-à-vis the importance of nutrition on pregnancy, a few observations need to be made.

The exact mechanism of the change in energy homeostasis during pregnancy is yet to be unravelled. Hence, recommendations on the energy intake during pregnancy are difficult to formulate. Due to changes in the metabolism in pregnancy, the evidence on which daily amounts of nutrients and vitamins in pregnancy are estimated may not be applicable and may not meet the advised daily amounts during pregnancy in healthy women, therefore, may not necessarily lead to a more favorable pregnancy outcome. Research results from studies carried out in women with nutritional deficiency of specific nutrients might not be readily applicable to healthy pregnant women. Also, prospective trials comparing different diets in healthy women are few, their quality differs and numbers are too small to draw any valid conclusions.

Only short-term health benefits are assessed. No information was collected on taking excessive nutrients. Lastly some studies, for example those with fish oil and calcium, may be promising in preventing preeclampsia and neurodevelopment of the fetus, but further research is needed.

The only vitamin of irrefutable importance is folic acid in its prevention of neural tube defects. Studies are of high quality and results are clear, which makes it frustrating that only 36% of Dutch women wishing to conceive actually use folic acid. Owing to this poor performance, methods to increase the compliance need to be explored, for example food fortification of cereals or flour, as is carried out in the United States and the UK. However, even than performance is poor. In 1998 in the UK, Rogers found only 9% of pregnant women taking folic acid before 18 weeks of pregnancy (74).
The evidence on the devastating effects of addiction to cigarettes, alcohol and drugs is sufficient to show that addictions are behavioral problems that require specialized care. New and innovative strategies should be explored, and their effects evaluated (75,76). These strategies should address individual needs.

**Five-year view**

The importance of specific nutrition during pregnancy in well-nourished women is not clear and the evidence on which recommendations on nutrition in pregnancy in The Netherlands are based is weak.

Only folic acid is an exception. Strategies aiming to increase its use, such as introducing food fortification of cereals or flour and mass campaigns on a regular basis, need to be reconsidered. Other initiatives to motivate women to start taking folic acid should be instigated. One such initiative involves pharmacists providing information on the importance of folic acid use in women using oral contraceptives or IUDs. This initiative increases awareness and the actual use.

Innovative strategies should be developed to reach the whole target population. Overall, the net health benefit of using folic acid to prevent neural tube defects by the whole target population might even be bigger than the health benefit of screening for such anomalies during pregnancy.

In the short term, the promising effects of, for example, fish oil on neurodevelopment of the fetus and calcium in order to prevent preeclampsia will be explored. In the long term, reducing perinatal morbidity and mortality worldwide by adding nutrients during pregnancy will be a research topic for many international scientists. In developing countries, research on how to improve nutritional status at the population level is the main focus. In (too) well-nourished populations, research must focus on different areas, such as the prevention of obesity and prevention of intrauterine growth retardation, including the Barker hypothesis, on the relation between cardiovascular diseases, metabolic syndrome and diabetes and low birth weight.

Research need to be carried out according strict protocols in large RCT’s.

Finally, since many pregnant women are hungry for information and sensitive to advice around changing their lifestyle, the collected evidence-based information should be widely available; as Fowles stated, “consistent individualized advices and counseling strategies addressing their individual needs should be explored” (18). This issue might be the most difficult to tackle.
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