Micronutrients during pregnancy: the nutritive situation in Germany

Peter Bung[1] MD, Reinhold Prinz-Langenohl[2] PhD, Barbara Thorand[2] PhD and Klaus Pietrzik[2] PhD

1. *University of Bonn, Germany, Womens' Hospital*
2. *University of Bonn, Germany, Institute of Nutritional Science, Dept. of Pathophysiology of Human Nutrition*

During pregnancy the demands for energy and nutrients are increased. Despite increasing awareness about nutrition in the population of a western country like Germany, there is a discrepancy between actual food intake and recommended quantities of certain nutrients, particularly during pregnancy. There are correlations between deficiencies in micro-nutrients such as iodine, iron and folic acid and the course and outcome of pregnancy. The consequences of an insufficient supply of these micronutrients during pregnancy are described and high-risk-groups for an inadequate supply are defined. Recommendations for nutrition counselling during this period of life are given.

Key words: Pregnancy, nutrition, micronutrients, folic acid, iodine, iron

Introduction

About one third of the German health budget is spent on the treatment of diseases and metabolic imbalances caused by nutritive "dis"-behavior; on the other hand only 3% is spent on preventive measures[1]. Medical thinking is becoming more preventive. There is an increase in requests for information about food and nutrition. The interest tends to be in micronutrients in general, and in certain periods of life such as pregnancy[2].

Critical micronutrients during pregnancy in Germany

Germany is classified as an iodine deficient country by the World Health Organization (WHO). Yet, it is accepted that it is possible to prevent the development of a struma by increasing iodine intake. During gestation, iron can be insufficient from food and thus often needs to be supplemented. Folic acid deficiency is the most common vitamin deficiency in the western world and it especially affects pregnant women.

This paper looks at these three critical micronutrients and their clinical importance during pregnancy.

Iodine

The overall goitre prevalence is 15.3% , with rates increasing from North to South[3]. The prevalence rate is especially high among girls and young women of childbearing age who thus start their pregnancies in deficiency. The daily iodine intake in Germany is only about 80µg in contrast to the recommended intake of 200µg/day[4]. Gestation requires an increase of 30µg/d (Table 1). This results in a net deficiency of 150µg/d for pregnant women.

What are the risks and consequences of such deficiency during pregnancy? The future mother may suffer from an enlargement of her thyroid or become infertile. Where pregnancy occurs there may be an increased risk of miscarriage in early to late pregnancy as well as preterm delivery[5]. Furthermore, the baby may be born with an enlarged thyroid gland (struma congenita). In up to 6% of the newborn in Germany a struma is diagnosed, mostly caused by iodine deficiency during pregnancy. Usually the struma is a compensatoric euthyroid enlargement of the gland, but hypothyroid metabolism is found in 1/3200 births[6].

Are there any preventive measures taken in our country? In general, the knowledge of the population about iodine content of food is poor. Only seafood is rich enough to contribute effectively to the iodine supply. Salt is enriched with iodine in Germany; however, iodized salt is not generally used by the population and many convenience foods do not contain iodized salt. Furthermore, it is now recommended to reduce salt intake and, therefore, the impact of this measure is limited. To avoid the described risks, pregnant women in Germany are advised to take daily supplements containing 200µg iodine.

Table 1. Recommended dietary allowances for women for selected micronutrients. (modified from (4))

	Basic allowance 19-50 years	Supplementary allowance for pregnant women	% increase during pregnancy
Energy intake	2200 kcal	+ 300 kcal	13.6%
Folic acid	150 µg	+ 150 µg	100%
Iron	15 µg	+ 15 µg	100%
Iodine	200 µg	+ 30 µg	15%

Iron

Pregnant women need 100% more iron than non-pregnant

This paper was presented at the International Workshop on 'Modern Lifestyles and Micronutrient Deficiency' in Nusa Dua, Bali on October 19-21, 1995.

Correspondence address: Associate Professor Peter Bung, University of Bonn, Womens' Hospital, Sigmund Freud Strasse 25, 53105 Bonn, Germany
Tel:+49-228-287-5449 Fax: +49-228-287-5446

women if no regard is paid to pre-conception stores (Table 1). Due to a lack of knowledge about food composition and preferred eating patterns to increase bioavailability, this extra need is seldom met with diet alone. The average daily iron intake of women in Germany is about 11mg[4]. The high demand for iron during pregnancy is not only caused by maternal tissue growth and the increasing needs of oxygen and oxygen-carriers, but also by fetal demands. The consequences of anaemia during gestation are multiple and well-known. They include increased maternal and fetal morbidity and mortality[7] and the risk of delivering children with low birth weight[8].

Which nutritional recommendations can be given to the general population and especially to pregnant women? Iron from meat is absorbed much better than iron from plant sources. Dietary fibre or tannins can reduce the absorption of non-heme iron by forming insoluble complexes with iron. Tannins are, for example, contained in black tea. Also, there are substances which promote iron absorption such as ascorbic acid. One can profit from this by drinking a glass of orange juice together with iron containing food. In Germany, it is common to use iron supplements during pregnancy to avoid iron deficiency (eg 100-200mg/d of iron sulfate).

Folic acid

The results of the National Nutritional Survey from 1991 indicate that the folate intake in large parts of the German population does not meet the recommendations of the German Society of Nutrition[9]. Comparing the recommendations for pregnant women with those for menstruating women, there is an increased energy demand of about 13% (= 300 kcal/d) for the second and third trimester of gestation. In contrast to this, folic acid recommendations are increased by 100% very early in pregnancy (Table 1).

What is the function of folic acid? The effective form of folic acid is 5,6,7,8-tetrahydrofolate (THF). THF is, for instance, essential for the synthesis of pyrimidines and purines in nucleotide metabolism. It is also necessary for the synthesis of amino acids, neurotransmitters, myelin and phospholipids. Therefore, folic acid is indispensable for cell-division, erythropoiesis and epithelial growth. In consequence, it is also essential for the process of growing and cell differentiation in the embryo and the fetus. The increase of folic acid requirements during pregnancy is caused by the accelerated cell-multiplication of the enlarged uterus and the mammae, the developing placenta, the expansion of the blood volume and, of course, by the growing fetus. In addition, there are increased renal losses and reduced absorption of folic acid during pregnancy [10-13].

What are the risks of a deficient folic acid supply during pregnancy? The most dramatic symptom arises in the very early embryonal period. A defect in the early stages of the development of the central nervous system leads to a neural tube defect (NTD). The incidence in Germany is estimated to be between 0.5 - 2 cases per 1000 births[14]. The spectrum of this disorder ranges from anencephaly to different forms of spina bifida. The pathogenesis of NTDs is not completely understood, but most cases result from an interaction between genetic and environmental factors such as nutritional status and socioeconomic situation[15]. Numerous retrospective[16] and prospective studies[17-20] have shown a relationship between folic acid insolu and NTDs. One possible metabolic disturbance causing NTDs may be a defect in the synthesis of methionine from homocysteine[21]. Folic acid functions as a cofactor of methionine-synthase, the enzyme which converts homocysteine into methionine. Consequently, a lack of folic acid can lead to hyperhomocysteinaemia with toxic effects on cells in general and impaired closure of the neural tube. Since folic acid supplementation has been effective in the prevention of NTDs in several intervention trials[19,20], folic acid supplementation in the periconceptional period is recommended by several institutions in Germany[14].

Furthermore, there seems to be a correlation between folic acid levels and miscarriages and repeated abortions[22]. A study from Bonn University compared plasma folate levels in pregnancies without complications with women suffering from miscarriages or repeated abortions. Significant differences were found between these groups. 18.9% of the women with abortion and 30.4% of the women with habitual abortion had a serum folate level < 5ng/ml in contrast to 6.3% in the control group (uncomplicated pregnancies)[23]. Furthermore, the fact that 50% of the women with genetically induced hyperhomocysteinemia suffer from miscarriages indicates the key role of folic acid in early pregnancy[24].

In the above mentioned study a high correlation between the socio-economic status of the pregnant women and their folate status was also observed: women from lower social classes were more often folate deficient and lacked of knowledge about ways to obtain sufficient folic acid. In the course of gestation - particularly in pregnancies without serious problems - significant differences were observed for plasma folate, red cell folate and hypersegmentation of the neutrophilic granulocytes between women who took folic acid containing supplements compared to non-supplemented women[25]. Often this difference correlated with clinical parameters of gestation: eg duration of gestation and weight and length of the newborn.

There are other consequences of inadequate dietary folic acid like reduced fertility, higher incidence of PET (pre-e toxaemia) and abruptio placentae.

Folic acid deficiency in pregnancy is nearly unavoidable for those women who begin pregnancy with a low folic acid status. Risk groups are women with poor knowledge about nutrition, young women whose folate stores are exhausted by puberty, women with pregnancies in quick succession or multiple pregnancy.

Informing about nutrition is the best way to increase folic acid intake. Vegetables, especially green leafy vegetables, liver and wholemeal bread are rich in folic acid. But folic acid is water-soluble and sensitive to light and heat so there may be loss of folic acid during food preparation. Therefore, supplementation with folic acid might be necessary in pregnancy when folate stores are deplete. Furthermore, for the prevention of NTDs it is recommended by several Health Authorities and Societies in Europe and the United States that all women of childbearing age should consume 400µg folic acid in addition to their normal diet. Those women who have already had a NTD affected child should consume 4mg/d additionally[14,26,27].

Other micronutrients

Extra needs for other micronutrients probably exist in the second half of gestation for the growing foetus. But, apart from high risk groups, supply by the daily diet seems to be otherwise adequate in Germany.

Micronutrients during pregnancy: the nutritive situation in Germany

Peter Bung, Reinhild Prinz-Langenohl, Barbara Thorand and Klaus Pietrzik

Asia Pacific Journal of Clinical Nutrition (1996) Volume 5, Number 3:161-163

孕期的微觀營養素：德國的營養狀況

摘要

孕期婦女能量和營養素的需要是增加的。盡管西方國家和德國的居民對營養認識有所增長，但是在食物攝取和建議某些營養素供應量方面，特別是孕期婦女，仍有分歧。微觀營養素如碘、鐵、葉酸的缺乏與懷孕的過程和結果有關。該文描述了孕期這些微觀營養素供應不足的後果，並確定了供應不足具高度危險性。作者並給予孕期婦女營養的建議。

References

1. Statistisches Jahrbuch, Statistisches Bundesamt (ed.) 1992
2. Pitkins R. Über die Aufgaben und Forschungsgebiete der Gegenwart und Zukunft. Dankesrede anläßlich der Verleihung der Ehrenmitgliedschaft der Deutschen Gesellschaft für Gynäkologie und Geburtshilfe, Berlin, 1992.
3. WHO. MDIS Working paper #1 - Global prevalence of iodine deficiency disorders. Geneve, 1993.
4. Deutsche Gesellschaft für Ernährung (DGE). Empfehlungen zur Nährstoffzufuhr. Frankfurt, Umschau- Verlag, 1991.
5. Rabe T. Gynäkologie und Geburtshilfe. Weinheim, VCH Verlagsgesellschaft Edition Medizin, 1990.
6. Stollhoff von K. Angeborene Hypothyreose. KEU 1994: 2: 20-21.
7. Llewellyn-Jones D. Severe anaemia in pregnancy. Australian and New Zealand Journal of Obstetrics and Gynaecology 1965: 5: 191-197.
8. Yusufji D, Mathan VI, Baker SJ. Iron, folate and vitamin B_{12} nutrition in pregnancy: a study of 1000 women from Southern India. Bull Wld Hlth Org 1973: 48: 15-22.
9. Nationale Verzehrsstudie. Projektträgerschaft "Forschung im Dienste der Gesundheit" in der Deutschen Forschungsanstalt für Luft- und Raumfahrt e.V. (ed.) im Auftrag des Bundesministeriums für Forschung und Technologie, Bremerhaven, 1991.
10. Landon MJ, Hytten FE. The excretion of folate in pregnancy. J Obstet Gynaecol Br Commonw 1971: 78: 769.
11. McPartlin J, Halligan A, Scott JM, Darling M, Weir DG. Accelerated folate breakdown in pregnancy. Lancet 1993: 341: 148-149.
12. Fleming AF. Urinary excretion of folate in pregnancy. J Obstet Gynaecol Br Commonw 1972: 79: 916-920.
13. Iyengar L, Babu S. Folic acid absorption in pregnancy. J Obstet Gynaecol Br Commonw 1975: 82: 20-23.
14. Koletzko B, v. Kries R. Prävention von Neuralrohrdefekten durch Folsäurezufuhr in der Frühschwangerschaft. Der Frauenarzt 1994: 35: 1007-1010.
15. Smithells RW, Sheppard S, Schorah CJ. Vitamin levels and neural tube defects. Arch Dis Child 1976: 51: 944-949.
16. Mulinare J, Cordero JF, Erickson JD, Berry RJ. Periconceptional use of multivitamins and the occurence of neural tube defects. J Am Med Assoc 1988: 260: 3141-3145.
17. Smithells RW, Nevin NC, Seller MJ, Sheppard S, Harris A, Read AP, Fielding DW, Walder S, Schorah CJ, Wild J. Further experience of vitamin supplementation for prevention of neural tube defect recurrences. Lancet 1983: 1: 1027-1031.
18. Milunsky A, Jick SS, Bruell CL, MacLaughlin DS, Rothmann KJ, Willett W. Multivitamin/folic acid supplementation in early pregnancies reduces the prevalence of neural of neural tube defects. JAMA 1989: 262: 2847-2852.
19. MRC Vitamin Study Research Group: Prevention of neural tube defects: results of the Medical Research Council Vitamin Study. Lancet 1991: 338: 131-137.
20. Czeizel AE, Dudas I. Prevention of the first occurence of neural tube defects by periconceptional vitamin supplementation. N Engl J Med 1992: 327: 1832-1835.
21. Steegers-Theunissen RPM, Boers GHJ, Trijbels FJM, Eskes TKAB. Neural-tube defects and derangement of homocysteine metabolism. N Engl J Med 1991: 324: 199-200.
22. Hibbard ED, Smithells RW. Folic acid metabolism and human embryopathie. Lancet 1965: 1: 1254.
23. Pietrzik K, Prinz R, Bung P, Chronides A, Mallmann P, Reusch K. Folate status and pregnancy outcome. In: Sauberlich HE, Machlin LJ, eds. Beyond deficiency: new views on the function and health effects of vitamins. Annals of the New York Academy of Sciences 1992: 669: 371-374.
24. Mudd SH, Skovby F, Levy HL, Pettigrew KD, Wilcken B, Pyeritz RE. The natural history of homocystinuria due to cystathionine ß-synthetase deficiency. Am J Hum Genet 1985: 37: 1-31.
25. Bung P, Stein C, Bauer O, Schlebusch H, Krebs D, Prinz R, Pietrzik K. Folsäureversorgung in der Schwangerschaft - Ergebnisse einer prospektiven Longitudinalstudie. Geburtsh u Frauenheilk 1993: 53: 92-99.
26. Centers of Disease Control and Prevention: Recommendations for use of folic acid to reduce number of spina bifida cases and other neural tube defects. JAMA 1993: 269: 1233-1238.
27. Netherlands Food and Nutrition Council. Report on the relationship between folic acid intake and neural-tube defects. The Hague, August 1992.