DIETARY INTERVENTION OR VITAMIN AND MINERAL SUPPLEMENTATION DURING PREGNANCY?

INTERWENCJA DIETETYCZNA CZY SUPLEMENTACJA WITAMINOWO-MINERALNA PODCZAS CIĄŻY?

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ABSTRACT

Introduction. Pregnancy increases demand for many minerals and vitamins. Most of them should be provided primarily in a well-balanced diet, not just by supplementation using pharmaceutical products.
Aim. The aim of the paper was to determine whether a correctly managed individual dietary intervention in pregnant patients leads to improvement of their nutrition and hence provision of necessary minerals and vitamins vital in terms of pregnancy.
Material and methods. 57 healthy pregnant women with a correct body mass index, aged 22–41 were enrolled. Diet of the participants was assessed three times: upon enrolment (before the dietary intervention was introduced), after week 10, and after week 18 based on their food diaries filled in on an on-going basis.
Results. Insufficient intake of most minerals and vitamins was noted prior to the dietary intervention. After 18 weeks of the intervention, clearly too low intake expressed as a percentage of recommended intake was noted for iron and folates. The diet did not provide the required amount of potassium as well.
Conclusions. Patients who underwent an 18 week dietary intervention during pregnancy are capable of providing sufficient amounts of most minerals and vitamins through a proper dietary balance. Folic acid is an exception and it should be provided from other sources as well. Pregnant women should also consider supplementation of iron as, according to the study, patients are capable of providing only half of the recommended intake of this important mineral. In order to complement potassium, intake of foodstuffs rich in this mineral should be increased.

KEYWORDS: diet in pregnancy, dietary intervention, pregnancy, supplementation, diet.

STRESZCZENIE

Wstęp. Podczas ciąży wzrasta zapotrzebowanie na wiele składników mineralnych i witamin. Pokrycie zapotrzebowania na większość z nich powinno być realizowane przede wszystkim poprzez prawidłowe bilansowanie diety, nie zaś wyłącznie poprzez suplementację preparatami farmaceutycznymi.
Cel. Celem pracy było zbadanie, czy odpowiednio prowadzona zindywidualizowana interwencja dietetyczna u pacjentek ciężarnych prowadzi do poprawy sposobu żywienia kobiet i związanego z tym pokrycia zapotrzebowania na ważne z punktu widzenia ciąży składniki mineralne i witaminy.
Materiał i metody. Do badań zgłosiło się 57 zdrowych kobiet ciężarnych z prawidłowym wskaźnikiem masy ciała (BMI), w wieku od 22–41 lat. Sposób żywienia badanych oceniany był – na podstawie prowadzonego przez pacjentki dzienniczka bieżącego notowania – trzykrotnie tj. po zgłoszeniu się do badań, czyli przed wdrożeniem interwencji dietetycznej oraz po 10 i 18 tygodniach jej przebiegu.
Wyniki. Przed rozpoczęciem interwencji żywieniowej obserwowano niedostateczną podaż większości składników mineralnych i witamin. Po 18 tygodniach interwencji zdecydowanie zbyt niskie spożycie, wyrażone jako procent normy spożycia, odnotowano wyłącznie w przypadku żelaza oraz folianów. Dieta nie pokrywała także w pełni zapotrzebowania na potas.
Wnioski. Pacjentki poddane podczas ciąży 18-tygodniowej interwencji dietetycznej są w stanie, poprzez prawidłowe bilansowanie diety, pokryć zapotrzebowanie na większość składników mineralnych i witamin. Wyjątek stanowi kwas foliowy, w którą to witaminę dieta powinna być uzupełniana (głównie z uwagi na profilaktykę wad cewy nerwowej). U ciężarnych należy rozważyć także suplementację żelaza, gdyż jak wynika z niniejszych badań, pacjentki są w stanie tylko w połowie pokryć zapotrzebowania na ten ważny składnik mineralny. Natomiast w celu uzupełnienia potasu w diecie, należałby zwiększyć spożycie bogatych w ten składnik mineralny nasion roślin strączkowych (które były w niewielkich ilościach uwzględniane przez ciężarne w jadłospisie) lub innych bogatych w potas produktów spożywczych.

SŁOWA KLUCZOWE: interwencja dietetyczna, ciąża, suplementacja, dieta.

Introduction

During pregnancy the demand for many minerals and vitamins increases. Pharmaceutical products that contain these nutrients should be used in justified cases as dietary supplements, not as an alternative to natural, wholegrain products, diary products, meat, fish, vegetables, or fruit.

Supplements of folic acid are an exception. They are recommended for women prior to conception and in pregnancy until the end of organogenesis. The recommended amount of folic acid to prevent development of open defects of the central nervous system is 0.4 mg a day. Folic acid is a key contributor to the process of production of nucleic acids (vital for correct division of foetal cells), participates in production of blood in the mother and the foetus, prevents premature labour, and low birth weight. Metabolism of homocysteine depends on correct intake of folic acid as well. It has been found that as a result of supplementation of folic acid in pregnant women prior to conception and in the first weeks of pregnancy, their children exhibited a significant reduction of occurrence of congenital disorders of the neural tube, including anacephaly, spina bifida, myelomeningocoele, and encephalocele [1–3].

Currently, complementation of folic acid products with vitamin B12 is being considered as B12 deficiency in pregnant women serum may increase the risk of neural tube defects in the foetus. During pregnancy blood concentration of this vitamin is reduced due to hemodilution, hormonal changes, variations of binding proteins levels, and increased transfer of B12 to the foetus, which is incapable of vitamin B12 synthesis [4].

In recent years, increasingly more attention is paid to properties of vitamin D. The primary role of vitamin D is to regulate calcium-phosphate metabolism. Studies have shown that maintenance of the right homoeostasis of vitamin D and calcium may decrease the risk of insulin resistance and type 2 diabetes; insufficient concentration of vitamin D has a negative impact on functions of pancreatic beta cells and insulin secretion [5]. Reduced mineralisation of the osseous tissue and even osteomalacia were found in multiparous women who gave births in short intervals and had calcium and vitamin D deficiency. Vitamin D affects also processes of transcription of over 200 genes and has tumour suppressive (reduced risk of some neoplasms), immunomodulating (activation of antibacterial peptides genes), and anti-inflammatory (restriction of cytokines secretion) properties. Natural sources of vitamin D include fish fats, but 80–100% of vitamin D is synthesised by the body upon skin exposure to UV radiation. It has been demonstrated that the supplementation of vitamin D3 reduces the risk of bacterial vaginosis related to some pregnancy complications. Nevertheless, recommendations to supplement vitamin D apply solely to women who live in countries with insufficient sun exposure or those who cover most of their body for cultural reasons. Recommended daily intake for pregnant and breast-feeding women with dietary D3 deficiency or limited skin synthesis was 800–1000 μg a day. Today the dose of 2000 IU a day is said to be justified [2, 6].

Iron and calcium are minerals of particular importance during pregnancy. Calcium is a component of the skeleton and improper intake of this mineral during pregnancy may result in metabolic complications in the mother and the foetus. The most common complications include osteopenia, osteoporosis, hyperaesthesia, dystonia in the mother and inhibited growth of the foetus with bone mineralisation disorders. Calcium demand increases in the second and third trimester and during lactation. The process of calcium absorption in the GI tract is influenced by vitamin D and organic acids, lactose, and indigestible oligosaccharides. Oxalates and phytates from diet inhibit absorption of calcium. High intake of proteins of animal origin, overuse of salt, and coffee are all related to excessive loss of calcium in the system. Maintaining the right calcium-phosphorus balance, which prevents bone resorption, is vital as well. The additional calcium demand should be satisfied with increased consumption of milk or dairy products [2, 7].

Women who eliminate dairy products from their diet (e.g. vegans, lactose-intolerant women, or those allergic to milk proteins) should eat substitute calcium-rich products, including calcium-fortified foods. Alternative sources of calcium include: beans, soy, eggs, fish whose fishbone is edible, almonds, nuts, dried figs, broccoli, and kale. Examples of calcium-fortified foodstuffs are vegetable milk, orange juice, tofu, wholemeal bread. According to numerous studies, water may be an important source of many minerals; it may be the most important source of calcium second to milk and dairy products. Water can be a good source of calcium if it contains more than 150 mg of calcium ions per litre [8].

It has been found that the combination of calcium supplementation and correct metabolism of vitamin D improves its bioavailability. Calcium is used as well as a vital component in preventing pre-eclampsia by normalisation of arterial pressure. Randomised studies demonstrated a significant reduction of incidence of pre-eclampsia achieved with calcium supplementation in high-risk nulliparous women [9–15].

The risk of calcium insufficiency is greater in people who avoid the sun, multiparous women, and breast-feeding women. Daily calcium demand increases in breast-feeding and young women and amounts to about

1200 mg, which, if not compensated for in diet, requires supplementation with oral preparations. The risk of preterm labour and low birth weight was found to be reduced in young pregnant women who received calcium supplementation. The beneficial influence of calcium on prevention of preterm labour probably results from the fact that it relaxes smooth muscles of the uterus [6, 16].

Iron deficiency in pregnancy may result in anaemia. Iron deficiency anaemia may cause preterm labour and low birth weight [16, 17]. First and foremost, an attempt should be made to include in the diet natural foodstuffs that contain iron, i.e. low-fat meat (in particular red meat), fish, dried fruit, wholegrain products, legumes, and other. If it is impossible to provide the adequate amount of iron, dietary supplementation should be commenced. A randomised study has confirmed that iron supplementation in mothers increased birth weight by over 200 g and limited the risk of low birth weight and preterm birth [18]. Supplementation with iron compounds should be implemented in particular in women who suffered from anaemia prior to conception and reinstated after week 8 of pregnancy. Iron supplementation is recommended in pregnant women with a risk of anaemia, i.e. in women on a vegan diet, in absorption disorders, and in women with anaemia (Hb < 11 mg/dl). It is also justified to continue intake of iron preparation during lactation as it reduces the risk of anaemia in the child [6].

During pregnancy, vitamins and minerals are important due to rapid metabolism and development of the foetus. Nevertheless, over-supplementation may be dangerous [19]. For example, the recommended daily intake of vitamin A in pregnant women above the age of 19 is 770 µg (20). Vitamin A insufficiency is a rare problem, but overdose may cause congenial disorders in the foetus. What is more, supplementation of vitamin A in doses exceeding the recommended dosage during pregnancy may be teratogenic [2, 6, 21].

Aim

The aim of this study was to determine whether an individualised dietary education in pregnant patients leads to improvement of their nutrition and hence provision of the sufficient amounts of all necessary minerals and vitamins vital in terms of pregnancy that are commonly taken in pregnancy as dietary supplements.

Material and methods

The study involved 57 pregnant women. All the pregnant women were notified orally and in writing prior to enrolment about detailed plan, assumptions, and scope of the study, and gave written consents to take part in the study. The study project was approved by the Independent Ethics Committee at the Karol Marcinkowski Medical University in Poznań (decision No. 248/10).

The women were provided care by a gynaecologist, and on average from week 16 of pregnancy of a dietician who provided a regular, individual dietary education programme. The mean age of patients at day 0 was 29.35±3.44 years; body mass index (BMI) was 22.04±2.52 (**Table 1**). For every participant, data for the period before the dietary intervention and for week 10 and 18 of the intervention collected in daily dietary logbooks was analysed using the Dietetyk 2 software (Institute for Food and Nutrition). Nutrition value of food rations was compared to the demand of each participant determined individually in relation to norms of the Institute for Food and Nutrition (20).

Statistical analysis

Mean values, standard deviation, and median were calculated, and the data analysed with the Wilcoxon test. The assumed statistical significance level was $p<0.05$.

Table 1. General profile of the study population

Parameter	n=57				
	Mean	Standard deviation	Median	Min.	Max.
enrolment (week of pregnancy)	15.91	4.97	15	8	23
age upon enrolment (years)	29.35	3.44	28	22	41
Body mass prior to pregnancy (kg)	62.97	7.84	61	49	86.6
Body height (m)	1.69	0.06	1.69	1.59	1.84
BMI prior to pregnancy (kg/m2)	22.04	2.52	21.6	18.78	31.43

Source: author's own analysis

Results

Prior to the dietary intervention, the study group exhibited insufficient intake of most minerals such as iron, potassium, calcium, and magnesium and vitamins: folates, vitamin D, niacin, vitamin B_1, and vitamin E. The degree of coverage of nutritional norms was verified against norms of the Institute for Food and Nutrition set individually for each patient (20).

After 10 weeks of the intervention, a statistically significant increase of intake of almost all vitamins and minerals that were insufficiently provided before was noted (except for niacin). After 8 more weeks of the intervention, too low intake (for only about a half of demand) expressed as a percentage of normal intake was noted for iron and folates. Moreover, the potassium content in diet was insignificantly lower than recommended (**Figures 1, 2**).

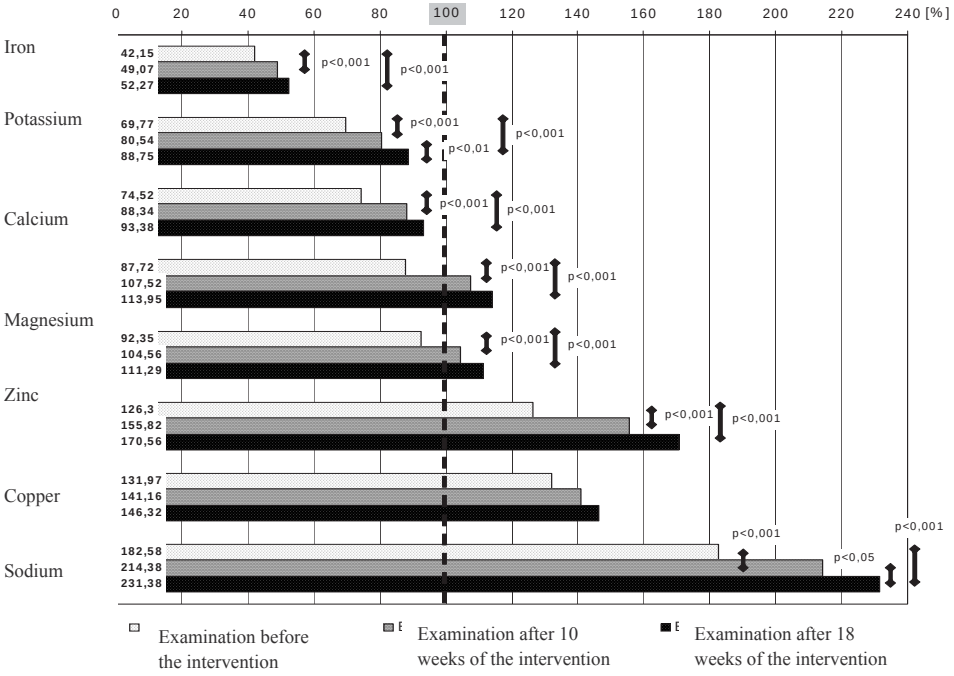

Figure 1. Changes in mineral content in DFI (daily food intake) as compared to the nutrition norm assessed after 10 and 18 weeks of the dietary intervention

Source: author's own analysis

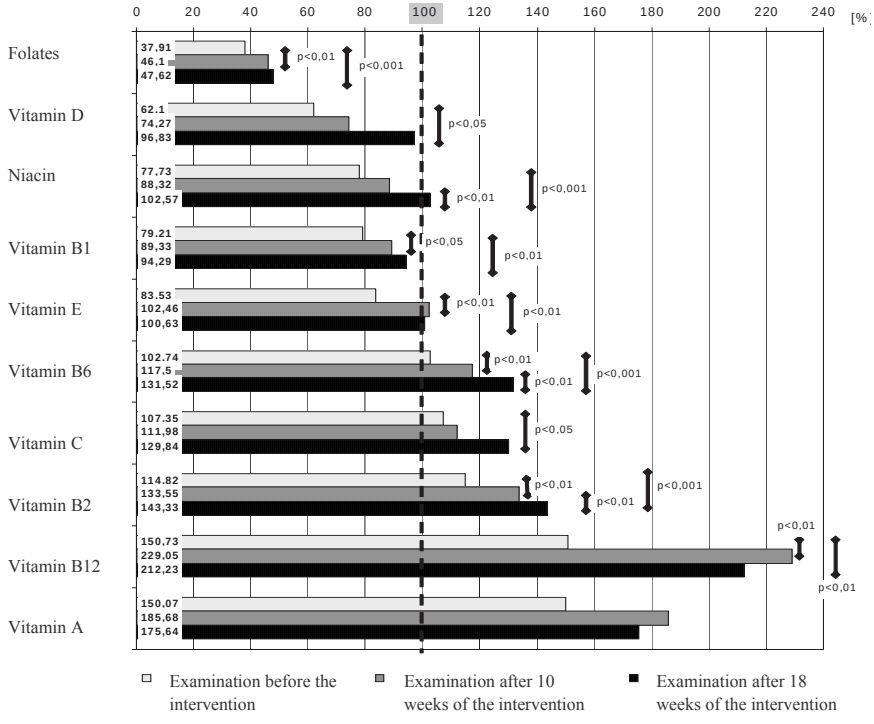

Figure 2. Changes in vitamin content in DFI (daily food intake) as compared to the nutrition standard assessed after 10 and 18 weeks of the dietary intervention

Source: author's own analysis

Discussion

Study results indicate that pregnant patients whose demand for many minerals and vitamins increases should first and foremost modify their diet so that it would provide nutrients necessary both for the mother and the foetus in a natural way. This facilitates much better results in terms of health than a substitution of varied diet with mineral and vitamin preparations [21].

Nevertheless, according to the study, it is extremely difficult to provide sufficient amount of folic acid with food. Folic acid should, therefore, be supplemented. An increased dose of folic acid should be used in obese patients, during the treatment of megaloblastic anaemia, in women who used the hormone contraception, antiepileptic drugs, smoked cigarettes, and in women who suffer from hyperhomocysteinaemia with reduced activity of methylene tetrahydrofolate reductase (MTHFR). If this enzymatic block is diagnosed, it is recommended to complement the diet with folic acid also in the form of active folates (no studies on complete substitution of folic acid with metafolin in prevention of open defects of the central nervous system) [6, 22–24].

Supplementation with mineral and vitamin preparations is also recommended in pregnant women with anaemia caused by iron deficiency, in pregnant women who eat small amounts of food of animal origin or vegetarians, in multiple pregnancies, and in HIV positive women. In vegans and lacto-ovo vegetarians, supplementation of vitamin B12 is also vital [25].

In regular pregnancies, the decision to supplement minerals and vitamins with preparations, on the other hand, should always be made after consulting a physician and analysing diet by a dietician who specialises in pregnancy nutrition. Supplementation should be aimed to provide nutrients that are necessary according to the physician providing prenatal care and that were found in insufficient amounts in diet analysis.

According to the study, despite 18 weeks of individual dietary intervention aimed to teach pregnant women how to correctly diversify diet, and the introduction of many changes to participants' diets, only about 50% of demand for folic acid and iron could be satisfied. Supplementation of these components throughout the whole period of pregnancy should therefore be necessary. Intake of potassium was also slightly below the norm. In this case, it would be enough to increase intake of legumes (which were included by pregnant women in their diets to a small extent) or other potassium-rich foodstuffs such as nuts, some fish, and wholegrain bread to cover demand norms.

Conclusions for practice

1. The 18 weeks of a dietary intervention improved diet of 57 pregnant participants. As a result of varied diet, the women were able to satisfy the demand for most minerals and vitamins except for folic acid, iron, and potassium.
2. All pregnant women should take folic acid supplement during pregnancy. What is more, iron supplementation should be considered individually as, according to the study, meeting nutritional norms during pregnancy when the demand is greater is impossible using only dietotherapy.
3. The decision to supplement other minerals and vitamins with dietary preparations, on the other hand, should each time be made after consulting a physician, analysing patient's health, individual dietary education, and analysing patient's diet by a dietician. Supplementation should be aimed to provide nutrients that were found to be deficient in diet analysis and are necessary as regards patient's health.

References

1. Lumley J, Watson L, Watson M et al. Peri-conceptional supplementation with folate and/or multivitamins for preventing neural tube defects. Cohrane of Systematic Reviews. 2009; Issue 4, Nr CD001056.
2. Bręborowicz GH, Ropacka M. Żywienie kobiet ciężarnych i karmiących. W: Gawęcki J, Grzymisławski M. (red.): Żywienie człowieka zdrowego i chorego. Tom II. Warszawa: Wydawnictwo Naukowe PWN; 2010. 340.
3. Wierzejska R, Jarosz M. Suplementy diety a okres rozrodczy i ciąża. W: Jarosz M. (red.): Suplementy diety a zdrowie. Warszawa: PZWL; 2011. 184.
4. Drews K. Aktywne wspomaganie szlaku folianów – epigenetyczny wpływ choliny i witaminy B12 na rozwój ciąży. Ginekol Pol. 2015; 86: 940–946.
5. Pittas AG, Dawson-Hughes BD, Li T et al. Vitamin D and Calcium Intake in Relation to Type 2 Diabetes in Women. Diabetes Care. 2006; 29.
6. Rekomendacje Polskiego Towarzystwa Ginekologicznego w zakresie stosowania witamin i mikroelementów u kobiet planujących ciążę, ciężarnych i karmiących. Ginekol Pol. 2014; 85: 395–399.
7. Buppasiri P, Lumbiganon P, Thinkhamrop J et al. Calcium supplementation (other than for preventing or treating hypertention) for improving pregnancy and infant outcomes. Cochrane Database Syst Rev. 2011.
8. Herrera JA, Arevalo-Herrera M, Herrera S. Prevention of preeclampsia by linoleic acid and calcium supplementation: a randomized controlled trial. Obstet Gynecol. 1998; 91: 585–590.
9. Crowther CA, Hiller JE, Pridmore B. Calcium supplementation in nulliparous women for the prevention of pregnancy–induced hypertension, preeclampsia and preterm birth: an Australian randomized trial FRACOG and the ACT Study Group. Aust. N.Z. J Obstet Gynaecol. 1999; 39: 12–18.

10. López-Jaramillo P, Narváez M, Weigel RM, Yépez R. Calcium supplementation reduces the risk of pregnancy–induced hypertension in an Andes population. Br J Obstet Gynaecol. 1989; 96: 648–655.
11. López-Jaramillo P, Narváez M, Felix C, Lopez A. Dietary calcium supplementation and prevention of pregnancy hypertension. Lancet. 1990; 335, 293 (letter).
12. López-Jaramillo P, Delgado F, Jacome P et al. Calcium supplementation and the risk of preeclampsia in Ecuadorian pregnant teenagers. Obstet Gynecol. 1997; 90: 162–167.
13. Sanchez-Ramos L, Briones DK, Kaunitz AM. Prevention of pregnancy–induced hypertension by calcium supplementation in angiotensin II–sensitive patients. Obstet Gynecol. 1994; 84: 349–353.
14. Belizán JM, Villar J, Gonzalez L, Campodonico L et al. Calcium supplementation to prevent hypertensive disorders of pregnancy. N Engl J Med. 1991; 325: 1399–1405.
15. Szostak-Węgierek D. Znaczenie prawidłowego żywienia kobiety przed oraz w czasie ciąży. Med Wieku Rozwoj. 2000; 4.
16. Zielke M. Zapotrzebowanie na wodę i ocena jej pobrania. W: Brzozowska A, Gawęcki J (red.): Woda w żywieniu i jej źródła, Poznań: Wydawnictwo Uniwersytetu Przyrodniczego w Poznaniu; 2008. 150.
17. Preziosi P, Prual A, Galan P et al. Effects of iron supplementation on the iron status of pregnant women: consequences for newborns. Am J Clin Nutr. 1997; 66 (5).
18. Cogswell ME, Parvanta I, Ickes L. Iron supplementation during pregnancy, anemia, and birth weight: A randomized controlled trial. Am J Clin Nutr. 2003; 78.
19. Franz MJ, Bantle JP, Beebe ChA. Evidence – Based Nutrition Principles and Recommendations for the Treatment and Prevention of Diabetes and Related Complications. Diabetes Care. 2002; 25 (1).
20. Jarosz M, Bułhak-Jachymczyk B. Normy żywienia człowieka. Podstawy prewencji otyłości i chorób niezakaznych. Warszawa: IŻiŻ; 2008.
21. Rothmann KJ, Moore LL, Singer MR. Teratogenicity of high vitamin A intake. N Engl J Med. 1995; 333 (21).
22. Seremak-Mrozikiewicz A, Barlik M, Borowczak P et al. The frequency of 677C>T polymorphism of MTHFR gene in the Polish population. Arch Perinat Med. 2013; 19(1): 12–18.
23. Scientific Opinion on (6S)-5-methyltetrahydrofolic acid, glucosamine salt as a source of folate added for nutritional purposes to food supplements. EFSA Panel on Food Additives and Nutrient Sources added to Food (ANS). European Food Safety Authority (EFSA), Parma, Italy. EFSA Journal.2013; 11(10): 3358. *http://*www.efsa.europa.eu/fr/efsajournal/doc/3358.pdf (access*: 2015-07-30).*
24. Barua S, Kuizon S, Junaid MA. Folic acid supplementation in pregnancy and implications in health and disease. J Biomed Science. 2014; 21: 77.
25. Position of the American Dietetic Association: Nutrition and Lifestyle for a Healthy Pregnancy Outcome. J Am Diet Assoc. 2008; 108.

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