FACTA UNIVERSITATIS
Series: **Working and Living Environmental Protection** Vol. 13, N° 3, 2016, pp. 239 - 245
DOI: 10.22190/FUWLEP1603239C

MONITORING OF THE NUTRITIONAL INTAKE OF FOLIC ACID AMONG PREGNANT WOMEN IN NIŠ

UDC 613.2:577.164.1:618.2(497.11Niš)

Maja Cvetković[1], Dušan Ilić[1], Maja Nikolić[1,2], Nenad Stošić[3], Marina Ranđelović[4]

[1]Faculty of Medicine, University of Niš, Department of Pharmacy, Niš, Serbia
[2]Institute for Public Health, Niš, Serbia
[3]Faculty of Medicine, University of Niš, Department of Dentistry, Niš, Serbia
[4]Center of Microbiology, Institute for Public Health, Niš, Serbia

Abstract. *The needs for micronutrients are increased during pregnancy primarily due to physiological changes and altered homeostatic control. Food, as the primary source of all nutrients, is not always sufficient to cover the increased needs, whereas the degree and frequency of nutritional deficiencies during pregnancy is various in demographic groups.*
The aim of this paper was to investigate the nutritional intake of folic acid among pregnant women in Niš, Serbia.
The research was conducted in 2014 and 2015 which included pregnant women who lived on the territory of the City of Niš, between 20 and 35 years of age. The study was conducted by using the random sampling methodology, with 25 respondents included.
In our pilot study, a high percentage of pregnant women in the observed sample did not meet the guidelines for the daily intake of folic acid which also brought about an insufficient intake of other nutrients that are essential for pregnancy. The results of the conducted study undoubtedly point out to the need to implement supplementation schema improvement policy based on the individual nutritional status of every pregnant woman in order to reduce the possibilities of both insufficient and excessive intake of dietary supplements and the immediate risk to the health of the fetus.
There is an imperative need to strategically and generally inform the female population on the importance of the folic acid intake as well as the consequences that can appear due to insufficient intake.

Key words: *folic acid, pregnant women, food, nutrition*

Received December 26, 2016 / Accepted January 10, 2017
Corresponding author: Maja Cvetković
Faculty of Medicine, University of Niš, Department of Pharmacy, Dr. Zoran Đinđić Blvd. 81, 18000 Niš, Serbia
E-mail: maja.celebrity@gmail.com

1. INTRODUCTION

The needs for micronutrients are increased during pregnancy primarily due to physiological changes and altered homeostatic control [1,2]. Food, as the primary source of all nutrients, is not always sufficient to cover the increased needs [3], whereas the degree and frequency of nutritional deficiencies during pregnancy is different in different demographic groups [4-6].

An adequate level of folic acid in the organism is required for normal cell division, regulation of synthesis of different molecules, including deoxyribonucleic and ribonucleic acid, regular brain and neurological function, regulation of homocysteine levels, as well as for the regular metabolism of B12 vitamin [7]. Due to faster cell division of both the fetus and the mother, there is an increased need for folic acid during pregnancy. The reasons for an increased intake of folic acid during pregnancy are also the growth of the uterus, increased blood volume, growth and development of the placenta and the fetus. The deficiency of folic acid in pregnancy is responsible for the defects of the fetus' neural tube, other neurological disorders, hyperactivity during childhood, premature birth and low birth weight [8,9].

It is recommended that pregnant women should eat food rich in folic acid and, for the prevention of the neural tube defect, they should increase folate intake before pregnancy, during pregnancy and in lactation [10]. Dietary supplementation can also be a good choice and there is a lot of discussion about this issue in pharmaceutical and medical professional public [11].

The aim of this paper was to investigate the nutritional intake of folic acid among pregnant women in Niš, Serbia.

2. METHODOLOGY

The research was conducted in 2014 and 2015 as a descriptive-analytical (transversal) study which included pregnant women who lived on the territory of the City of Niš (Serbia) between 20 and 35 years of age. The study was conducted by using the random sampling methodology in selecting pregnant women among the patients of "Dona" Pharmacy Health Care Institution in Niš. The desired sample for the study included 25 respondents. The criteria for the participation in the study were the absence of chronic diseases, use of medications and non-smoking status. The study was conducted in accordance with the Declaration of Helsinki [12].

The respondents were firstly informed about the goals of the research, and the percentage of respondents who refused to participate in the research was about 15%. The validated " The 24-hour recall diet" [13], which includes the data on the type and quantity of food a person ate over the past 24 hours, was used to determine the average daily intake of folic acid in respondents. The research was conducted by using the interview method. The originally-structured epidemiological questionnaire was used for the collection of information on socio-demographic characteristics, marital status and reproductive history. In the second part of the survey, pregnant women responded to questions on the type of nutrition, quantity of consumed food, portion size and the manner of preparation, in the morning, in the afternoon and in the evening, according to their memory. The average daily intake of folic acid from the surveys was calculated by using the food composition tables [14,15].

The statistical analysis of the results of this research was carried out by the methods of descriptive and analytical statistics by using *Excel 7.0* in *Windows 2007* environment.

3. RESULTS

The final study sample included 25 pregnant women whose basic characteristics are presented in Table 1. The average age of the participants was 26.52±4.37 years. Three out of 25 pregnant women reported spontaneous abortions in their reproductive history. There were some problems in pregnancy noted in pregnant women over thirty years of age. The results showed that the risk of pregnancy complications was significantly higher in women over thirty years of age than in younger women ($p<0.001$).

Table 1 Demographic characteristics of the respondents (n=25)

Characteristic		Education		Employment status		Marital status		Reproductive history	
Age (in years)	Number								
<25	10	primary	3	employed	16	married	19	with complications	3
25–29	8	secondary	13	unemployed	9	single	6	without complications	22
>30	7	higher	9						

The survey determined that the most frequently consumed food was bread, white meat, cheese, eggs, bananas, apples, Fig. 1.

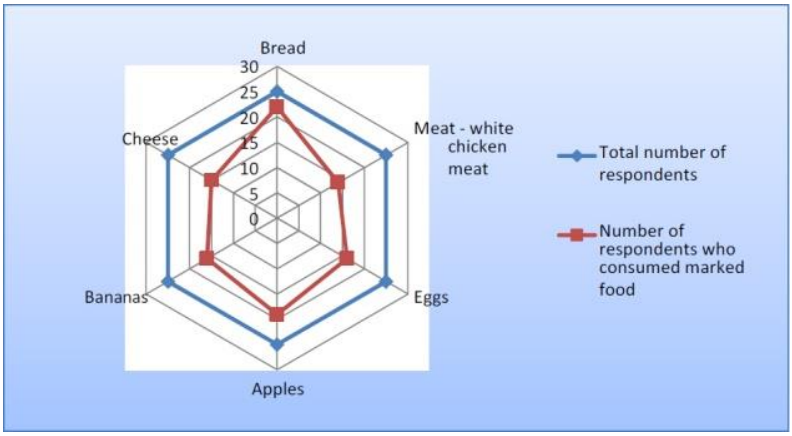

Fig. 1 The representation of the most commonly consumed food in daily meals of the respondents

Out of the total number of surveyed pregnant women, 22 (88%) of them reported the use of bread, 14 (56%) of them consumed white chicken meat, 16 (64%) ate eggs, 19 (76%) reported that they ate apples, 17 (68%) consumed bananas, whereas 15 (60%) ate cheese.

According to the 24-hour recall diet and the obtained results on the amount of consumed food, the daily intake of folic acid was determined in the surveyed pregnant women.

4. DISCUSSION

In our pilot study, the food the surveyed pregnant women most commonly ate was not a good source of folic acid. The content of folic acid in groceries the respondents usually consumed through food was: bread 15μg, white chicken meat 3.1 μg, bananas 9.6 μg, apples 0.5 μg, cheese 46 μg, eggs 5.1 μg in 100g of consumed food (groceries). Therefore, a high percentage of pregnant women in the observed sample did not meet the guidelines for the daily intake of folic acid and that also brings about an insufficient intake of other nutrients that are essential for pregnancy. Age and education of the respondents were not directly related to the adequate intake of folic acid. Our study showed that age and level of education were compatible parameters. Namely, the respondents with a higher level of education and more mature age has a more positive attitude toward the significance of folic acid for the development of the fetus, which can be explained by a more responsible relationship toward the state in which they were (Tables 2 and 3).

Table 2 Relationship between the respondents' age and the daily intake of folic acid

Respondents' age (years)	Daily intake of folic acid (μg)
<25	115.71
25-29	155.73
>30	207.31

Table 3 Relationship between the respondents' level of education and the daily intake of folic acid

Level of education	Daily intake of folic acid (μg)
Primary	101.97
Secondary	135.21
Higher	198.93

A balanced nutrition, rich in nutrients, is essential and needs to be promoted among women in the reproductive period in order to avoid the risk of insufficient intake of certain vitamins and minerals. The results of the conducted study undoubtedly point out to the need for the implementation of the supplementation schema improvement policy based on the individual nutritional status of every pregnant woman in order to reduce the possibilities of both insufficient and excessive intake of dietary supplements and the immediate risk to the health of the fetus. The monitoring of the nutritional status of pregnant women is important and it represents a good starting point. However, based on these findings, it would be necessary to implement some intermediary programs that would take into consideration social and cultural contexts and guarantee for the healthier food production.

Since the intake of this vitamin was insufficient, the use of supplements with the appropriate folic acid content was justified. In nutritional terms, pregnancy is one of the most demanding periods in a woman's life. During pregnancy, nutritional needs are increased in order to secure fetal growth and development and in order to support metabolic needs of the mother and the development of tissues specific for reproduction. It is recommended that the increased needs for proteins, carbohydrates, fats, as well as vitamins and minerals should be met with a well-balanced and varied diet, and in cases where that is impossible to be achieved, from subjective or objective reasons (nausea, vomiting), dietary supplements should be used. Supplement doses that are recommended to pregnant women are 400 micrograms per day. Pregnant women who have a potential risk for their babies to get *spina bifida* are the ones who take medications that inhibit the effect of folate (methotrexate), the ones who take antiepileptic drugs and have BMI over 30 or diabetics, and their advised dose of folic acid is 5 mg a month before planned pregnancy and in the first trimester of pregnancy [17,18]. There

are different attitudes and recommendations regarding the use of dietary supplements in pregnancy in many national areas, and that indicates that the use of supplements greatly depends on demographic, social and economic parameters [19]. In Serbia, with the exception of the recommendations for the supplementation of folic acid, recommendations that would relate to the use of certain groceries rich in folic acid during pregnancy have not been created yet, so it is all mostly left to the recommendations of gynecologists or individual choices of pregnant women. It is therefore essential for pregnant women to be educated and properly informed on the significance of the intake of folic acid through food so they can meet their specific needs without the use of additional folic acid preparations. Our research confirmed the hypothesis that the respondents did not take sufficient amounts of folic acid through food. The mean value of folic acid intake in pregnant women was 155 µg, which below the recommended daily amount of 400 µg (Fig. 2).

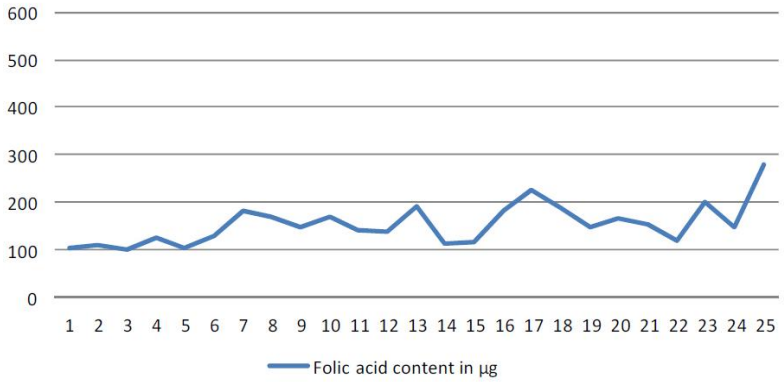

Fig. 2 Daily intake of folic acid in surveyed pregnant women in micrograms

The fact that only 15% of women took folic acid in the form of supplements as an additional source of vitamins is also very significant. Daily needs for folic acid can be met by proper and controlled diet, that is, by taking appropriate food. Cereals are a great source of folic acid and they supply the body with 100 – 400 µg of folic acid during only one meal [20]. Nuts are also good sources of folic acid. The amount of 100g of hazelnuts, cashews, pistachios, almonds and walnuts contains 113, 113, 51, 29 and 98 µg of folic acid respectively. Vegetables are also a very good source of folic acid. A half of a cup of cooked spinach satisfies 33% of daily needs for folic acid. Other vegetables rich in folates are cauliflower, cabbage, green peppers, zucchinis and cucumbers [21]. Egg yolks are also a rich source of essential fatty acids (especially DHA), which are important for the growth and development of the central nervous system. Egg yolks contain choline, a compound that has a significant role in the development and function of the baby's brain. Its deficit causes the lack of folic acid, but it is easy to compensate it – (one large egg provides nearly a half of the daily choline requirements). Legumes have high levels of folates and fibers, as well as proteins with low fat levels. One cup of cooked lentils supplies the organism with 90% of the recommended daily dose of folic acid, which makes them the best source. Only 100g of chickpea contain as much as 334.2µg or 53.5% of the recommended daily intake of folic acid. A half of a cup of cooked peas covers 35% of daily needs for folic acid, whereas

a half of a cup of white beans covers 29% [20]. Recommendations differ, but it is advised in most countries (69.4%) that a healthy diet should be combined with 400 μg/d of folic acid supplements in the period from 4-12 weeks before the planned pregnancy until the end of the first trimester. The same recommendations are also issued by the World Health Organization (WHO). The doses for women at high risk go up to 4–5 mg/d. WHO recommends the daily intake of folates from 300–400 μg for women in the reproductive period and 500-600μg for pregnant women. In some countries, the importance of healthy diet is emphasized, and supplementation is considered unnecessary. In contrast, in other countries, healthy diet is promoted with the obligatory additional supplementation of folic acid. Finally, the professional public shyly mentions the importance of providing an adequate folate status and it advises control prior to potential use of supplements.

There are various recommendations worldwide regarding folates and folic acid, all with a goal to prevent adverse effects, but most countries, as well as WHO, have put their focus on a healthy diet and folic acid supplementation in the dose of 400 μg/d.

5. CONCLUSION

The research showed that pregnant women who participated in the study did not take adequate amounts of folic acid through food, and that can be a reason for the occurrence of various disorders of the fetus.

There is an imperative need to strategically and generally inform the female population on the importance of the folic acid intake as well as the consequences that can appear due to insufficient intake. That certainly and inevitably involves a diet rich in cereals, green vegetables, legumes and fruit, as well as supplementation, all in order to reduce the occurrence of *spina bifida* and *anencephaly* in newborns.

REFERENCES

1. Institute of Medicine. Subcommittee on Nutritional Status and Weight Gain during, Pregnancy. Nutrition during pregnancy. Part I: weight gain. Part II: nutrient supplements.Washington, DC: National Academy of Sciences; 1990.
2. Picciano MF. Pregnancy and lactation: physiological adjustments, nutritional requirements and the role of dietary supplements. J Nutr. 2003;133:S1997–2002.
3. Turner RE, Langkamp-Henken B, Littell RC, Lukowski MJ, Suarez MF.Comparing nutrient intake from food to the estimated average re-quirements shows middle- to upper-income pregnant women lack iron and possibly magnesium. J Am Diet Assoc.2003;103:461- 6.
4. Kaiser L, Allen LH, American Dietetic Association. Position of the American Dietetic Association: nutrition and lifestyle for a healthy pregnancy outcome. J Am Diet Assoc. 2008;108:553–61.
5. Hoellen F, Hornemann A, Haertel C, Reh A, Rody A, Schneider S, Tuschy B, Bohlmann MK. Does maternal underweight prior to conception influence pregnancy risks and outcome? In Vivo. 2014; 28(6):1165-70.
6. Musa MG, Torrens C, Clough GF.The microvasculature: a target for nutritional programming and later risk of cardio-metabolic disease.Acta Physiol (Oxf). 2014 ;210(1):31-45.
7. Kocic G., Bjelakovic G., Djordjevic V., Nikolic J., Pavlovic D., Koraćević D., Biohemija, Savremena administracija, Beograd 2006
8. Banjari I, Matoković V, Škoro V. The question is whether intake of folic acid from diet alone during pregnancy is sufficient. Med pregl 2014; 67(9-10): 313-321.
9. Schlotz W1, Jones A, Phillips DI, Gale CR, Robinson SM, Godfrey KM. Lower maternal folate status in early pregnancy is associated with childhood hyperactivity and peer problems in offspring. J Child Psychol Psychiatry. 2010;51(5):594-602.

10. Wilson RD; Genetics Committee, Wilson RD, Audibert F, Brock JA, Carroll J, Cartier L. et al. Pre-conception Folic Acid and Multivitamin Supplementation for the Primary and Secondary Prevention of Neural Tube Defects and Other Folic Acid-Sensitive Congenital Anomalies. J Obstet Gynaecol Can. 2015 ;37(6):534-52.
11. Chitayat D, Matsui D, Amitai Y, Kennedy D, Vohra S, Rieder M, Koren G. Folic acid supplementation for pregnant women and those planning pregnancy: 2015 update. J Clin Pharmacol. 2015 Aug 13. doi: 10.1002/jcph.616.
12. http://www.wma.net/en/30publications/10policies/b3/17c.pdf
13. Nikolić M. Ur. Dijetetika, Medicinski fakultet u Nišu, Niš. 2008.
14. Jokić N, Dimić M, Pavlica M. Tablice hemijskog sastava prehrambenih proizvoda, Zavod za ekonomiku stanovništva Srbije, Beograd,1999.
15. Brodarec A. Tablice o sastavu i prehrambenoj vrijednosti namirnica i pića, Zavod za zaštitu zdravlja Hrvatske, Zagreb 1976.
16. Bestwick JP, Huttly WJ, Morris JK, Wald NJ. Prevention of neural tube defects: a cross-sectional study of the uptake of folic acid supplementation in nearly half a million women. PloS one 2014; 9(2):e89354.
17. Amitai Y, Koren G. The Folic Acid Rescue Strategy: High-Dose Folic Acid Supplementation in Early Pregnancy.JAMA Pediatr. 2015 5:1-2.
18. Gomes S1, Lopes C1, Pinto E2. Folate and folic acid in the periconceptional period: recommendations from official health organizations in thirty-six countries worldwide and WHO. Public Health Nutr. 2015 16:1-14. [Epub ahead of print]
19. Ivanović N, Đorđević B. Opravdanost upotrebe dodataka ishrane u populaciji trudnica.Arhiv za farmaciju 2014; 64(5):438-451.
20. Gujska G. Majewska K. (2005): Effect of Baking Process on Added Folic Acid and Endogenous Folates Stability in Wheat and Rye Breads, Plant Foods for Human Nutrition, 60, str. 37-42.
21. Klein BP, Kuo CHY, Boyd G. Folacin and ascorbic acid retention fresh raw, microwave, and conventionally cooked spinach, Journal of Food Science (1981); 46: 640-641

PRAĆENJE NUTRITIVNOG UNOSA FOLNE KISELINE KOD TRUDNICA U NIŠU

Potrebe za mikronutrijentima tokom trudnoće se povećavaju i to pre svega zbog fizioloških promena i izmenjenoj homeostatskoj kontroli. Hrana kao primarni izvor svih nutrijenata, nije uvek i dovoljana za povećane potrebe, a stepen i učestalost nutritivnih deficita tokom trudnoće se razlikuju u različitim demografskim grupama.

Cilj ovog rada bio je ispitati nutritivni unos folne kiseline kod trudnica u Nišu, Srbija.

Ispitivanje je sprovedeno u 2014. i 2015. godine kojom su obuhvaćene trudnice koje žive na teritoriji grada Niša uzrasta od 20 do 35 godina. Željeni uzorak ispitivanja je činilo 25 ispitanica.

U našoj pilot studiji namirnice koje su ispitivane trudnice najčešće koristile u ishrani su bile slab izvor folne kiseline. Shodno tome, visok procenat trudnica u posmatranom uzorku nije ispunio smernice za dnevni unos folne kiseline a to povlaci sa sobom i nedovoljan unos drugih hranljivih materija bitnih za period trudnoće. Rezultati sprovedene studije nedvosmisleno nameću potrebu sprovođenja politike poboljšanja suplementacionih šema zasnovanih na individualnom nutricionom statusu svake trudnice, u cilju smanjenja mogućnosti, kako nedovoljnog, tako i prekomernog unosa dodataka ishrani i neposrednog rizika po zdravlje ploda.

Imperativno se nameće potreba o strateškoj opštoj informisanosti ženske populacije o važnosti unosa folne kiseline kao i posledicama koje mogu da se jave usled niskog unosa iste.

Ključne reči: *folna kiselina, trudnice, hrana, ishrana*