ORIGINAL ARTICLES AAEM

Ann Agric Environ Med 2011, 18, 169–174

NUTRITIONAL BEHAVIOURS AMONG PREGNANT WOMEN FROM RURAL AND URBAN ENVIRONMENTS IN POLAND

Andrzej Wojtyła[1], Iwona Bojar[2], Peter Boyle[3], Witold Zatoński[4], Jerzy T. Marcinkowski[5], Przemysław Biliński[6]

[1]Institute of Rural Health, Lublin, Poland
[2]National Observatory for Health and Work Safety of Agricultural Workers, Institute of Rural Health, Lublin, Poland
[3]International Prevention Research Institute, Lyon, France
[4]Oncology Centre – Institute, Warsaw, Poland
[5]Chair of Social Medicine, Poznan University of Medical Sciences, Poznań, Poland
[6]Chief Sanitary Inspectorate, Poland

Wojtyła A, Bojar I, Boyle P, Zatoński W, Marcinkowski JT, Biliński P: Nutritional behaviours among pregnant women from rural and urban environments in Poland. *Ann Agric Environ Med* 2011, **18**, 169–174.

Abstract: Based on data obtained from the system MoZMaD – PL (Polish Mother and Child Health Monitoring System); an equivalent of the American system PRAMS (Pregnancy Risk Assessment Monitoring System). The health behaviour of a pregnant woman, including adequate nutritional behaviours and supply of all the necessary nutrients, exert an effect on the health of a woman, development of the foetus, and the occurrence of diseases among the offspring at the age of maturity. The objective of the study was analysis of the nutritional behaviours among Polish pregnant women, with particular consideration of the recognition of dietary changes caused by the fact of becoming pregnant. The studies were based on questionnaire forms within the Polish Mother and Child Heath Monitoring System (MoZMaD – PL) implemented in Poland. The precise day of studies is appointed annually for the whole of Poland by the Chief Sanitary Inspector. The questionnaire forms were correctly completed in 2010 by 2,877 women. The replies to the questions were introduced by surveyors into the MoZMaD – PL system, a central database managed by the Institute of Agricultural Medicine. The results obtained were subjected to statistical analysis. More than a half of Polish women change their diet in pregnancy. According to the pregnant women examined, the changes in their diet consist in a more frequent consumption of white meat, fish, fruits and vegetables, as well as milk and dairy products. Favourable changes in diet were observed primarily among the respondents from the urban environment. Considering an insufficient awareness with respect to nutritional behaviours among females at reproductive age, the education of pregnant women and those who plan a pregnancy concerning an adequate diet should be jointly conducted by medical circles, schools, and the media, and directed primarily to women from the rural environment.

Address for correspondence: Iwona Bojar, National Observatory for Health and Work Safety of Agricultural Workers, Institute of Rural Health, Jaczewskiego 2, 20-090 Lublin, Poland. E-mail: ibojar@poczta.onet.pl

Key words: health behaviour, diet, pregnant women.

INTRODUCTION

The organism of a pregnant woman is the environment for the developing foetus. Inadequate nutrition of the mother in pregnancy, especially during the third trimester of pregnancy, is the cause of low birth weight (LBW) in the developing countries [17, 24]. LBW is associated with an increased risk of foetal morbidity and mortality [23], and after delivery, with delayed growth, which may have unfavourable long-term effects on the physical and mental

Received: 21 March 2011
Accepted: 29 May 2011

development of infants, such as cardiovascular diseases and type 2 diabetes [3]. An inadequate diet of a women in pregnancy is also connected with the risk of arterial hypertension during the period of pregnancy, and obesity in later life [13, 19]. Therefore, the health behaviours of a woman in pregnancy, including adequate nutritional behaviours and supply of all the necessary nutrients, affect the woman's health, development of the foetus and occurrence of diseases in the offspring at the age of maturity [1, 3, 4, 5, 13, 14, 15, 19].

The nutrition of a woman during pregnancy does not deviate much from the principles of rational nutrition for each of us. In association with the new life conceived and developing in her womb, the energetic demand increases by approximately 300 kcal during the 2nd and 3rd trimester of pregnancy [22].

An increase in body weight in pregnancy was specified in 1990 by the American Health Institute, updated in 2009, based on tendencies observed in body weight increase during pregnancy from the beginning of the 1990s among pregnant women in the USA [21].

In addition, the Committee on Nutritional Status during Pregnancy and Lactation allows in the case of multiple pregnancy a higher increase in body weight during the period of pregnancy. Thus, with relation to women with normal body weight before becoming pregnant this increase may be 17–25 kg, women with overweight – 14–23 kg, whereas those who are obese 11–19 kg. Such standards concern women bearing babies from multiple pregnancy with the body weight over 2,500 g and between 37–42 weeks of pregnancy, i.e. with normal weight and maturity (Tab. 1).

While specifying the energetic demands of the organism of a pregnant woman attention should be paid to such elements as, e.g. her age, current nutritional status (obesity, underweight), life style, physical effort or type of occupation performed.

The daily number of the portions of food products from individual groups suggested for pregnant women is presented in the form of a nutritional food pyramid for pregnant women, proposed by the WHO [16].

Pregnant women should select products for their daily diet in such a way that it contains 9 servings of the group of products containing carbohydrates, 4 servings of vegetables, 3 servings of fruit, and 3 servings each of dairy products, and containing meat, fish, eggs and nuts, and sporadically, fats and sweets.

According to the results of the recommendations by the WHO, the rational diet of a pregnant woman should supply an adequate amount of energy, and should also include indispensable nutrients (i.e. proteins, fats, carbohydrates, minerals and vitamins) in appropriate amounts and proportions. An adequate content of good quality beverages in the everyday diet is also important.

Dietary errors of pregnant women occur when the daily menu does not fully cover an increased demand for individual nutrients. Sometimes, in meals consumed daily by the women, there is an insufficient amount of microelements and vitamins. However, it should be remembered that also an excessive amount of food products consumed, and an additional supplementation of vitamins and microelements, may be hazardous for the mother and the developing foetus.

Table 1. Recommendations concerning body weight in women during the period of pregnancy.

BMI prior to pregnancy [kg/m^2]	Total weight increase during pregnancy [kg]	Body weight increase in the 2nd and 3rd trimester of pregnancy per week (mean) [kg]
Underweight (< 18.5)	12.5–18	0.44–0.58 (0.51)
Normal weight (18.5–24.9)	11.5–16	0.35–0.50 (0.42)
Overweight (25.0–29.9)	7–11.5	0.23–0.33 (0.28)
Obesity (30)	5–9	0.17–0.27 (0.22)

According to: Committee on Nutritional Status during Pregnancy and Lactation, Institute of Medicine, National Academy of Sciences, 2009, modified.

Approximately 60% of the total amount of daily demand for proteins are those of animal origin, the main source of which is milk and dairy products, as well as meat, poultry and fish. The remaining 40% should come from valuable plant proteins, e.g. pulses.

Pregnant women also have an increased demand for some indispensable fatty acids – linoleic acid and alpha-linoleic acid [16].

The contents of carbohydrates in the daily diet of expectant mothers should be 400 grams daily, on average. During pregnancy an excessive amount of sweets and confectionery should not be consumed, while the consumption of complex carbohydrates is recommended.

According to the recommendations by the WHO and EU, the supply of over 400 g/day of fruits and vegetables covers the daily demand for vitamins and minerals [16].

The objective of the study was analysis of the nutritional behaviours among pregnant women in Poland, with particular consideration of the recognition of changes in their diet caused by the fact of becoming pregnant.

METHODS

The studies were conducted with the use of questionnaire forms within the Polish Mother and Child Health Monitoring System (MoZMaD – PL) implemented in Poland. The survey was carried out by trained surveyors – employees of regional and provincial sanitary stations (a total number of more than 600 surveyors), on the same day in each calendar year, simultaneously in all Polish hospitals where mothers after childbirth were hospitalized together with their newborn babies. Consent to conduct the survey was expressed by the following number of hospitals, in 2010 – 373 (which constituted 94% of all hospitals in

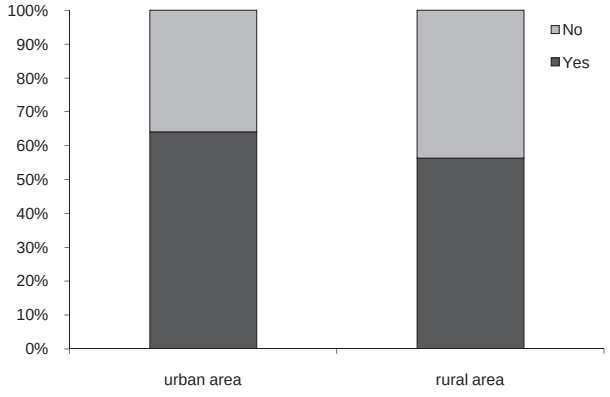

Figure 1. Changing your diet after becoming pregnant.

Poland where deliveries occurred). Most frequently the survey was carried out within the first 3 days after childbirth. The mothers and neonates hospitalized for a period longer than 3 days (pathological deliveries, with Caesarean section performed, premature babies with low birth weight, defects or severe condition after birth) were surveyed after this time, according to the hospitalization time.

The exact day of the survey is designated annually for the whole of Poland by the Chief Sanitary Inspector. The survey consists of 2 sections: the first section – completed by the hospitalized mother, and the second section – completed by the medical staff (a physician or nurse) providing hospital care for the mother and her baby. In 2010, 3,980 women were asked to complete the questionnaire form, hospitalized on the specified day in all Polish hospitals. Each time, the managers of the hospitals expressed their permission to conduct the research. Consent was also obtained from Bioethical Commission. The questionnaire forms were correctly completed in 2010 by 2,877 women. This means that 77.83% of women who were asked to answer the survey questions provided their replies, as did the same percentage of medical staff taking care of expectant mothers. The replies to the questions were introduced by the surveyors into the Polish Mother and Child Health Monitoring System (MoZMaD – PL), the central database managed by the Institute of Agricultural Medicine.

The presented study shows the results of research for 2010 concerning nutritional behaviours in pregnancy.

The results of the studies obtained were subjected to statistical analysis. The relationships between variables were evaluated with the use of the chi-square test of independence, and chi-square test of independence with Yate's correction. The p values $p<0.05$ were considered statistically significant.

RESULTS

The majority of pregnant women in the study group were married (82%), approximately 10% of respondents lived in informal partnerships, less than 7% were unmarried, whereas only 1% of the respondents were divorced and 4 widowed.

Table 2. Changes in diet during pregnancy.

Change in your diet to-date consisted in:	Urban area n (%)	Rural area n (%)	p
Avoiding consumption of red meat (beef, pork)			
No	883 (87.00)	572 (87.20)	ns
Yes	132 (13.00)	84 (12.80)	
More frequent consumption of red meat (beef, pork)			
No	904 (89.06)	596 (90.85)	ns
Yes	111 (10.94)	60 (9.15)	
More frequent consumption of white meat (poultry)			
No	717 (70.64)	454 (69.21)	ns
Yes	298 (29.36)	202 (30.79)	
Avoiding consumption of white meat (poultry)			
No	989 (97.44)	634 (96.65)	ns
Yes	26 (2.56)	22 (3.35)	
More frequent consumption of fish			
No	557 (54.88)	410 (62.50)	<0.05
Yes	458 (45.12)	246 (37.50)	
More frequent consumption of fruits and vegetables			
No	196 (19.31)	144 (21.95)	ns
Yes	819 (80.69)	512 (78.05)	
More frequent consumption of plant oils			
No	882 (86.90)	597 (91.01)	<0.05
Yes	133 (13.10)	59 (8.99)	
More frequent consumption of milk and dairy products (kefir, cheese, yogurt) and eggs			
No	319 (31.43)	205 (31.25)	ns
Yes	696 (68.57)	451 (68.75)	
Total (% of total)	1015 (60.74)	656 (39.26)	1,671 (100)

The smallest percentage constituted women without education (only 2 respondents examined declared lack of education), the percentages of those with elementary and junior school education level were also low: 3.6% and 2.8%, respectively. Pregnant women with elementary vocational education level constituted approximately 15% of respondents, whereas the percentage of those who possessed secondary school education was 9.15%. The largest number of respondents had university Master's degree or post-secondary school education – 30.9% and 23.8%, respectively.

Analysis of the women examined in 3-year age categories showed that the smallest group constituted women aged under 23 (12.7%), and those over 34 (14.6%). Nevertheless, with the exception of the age group 26–28, which was the largest (23.4%), the remaining age groups were characterized by a similar percentage distribution by age.

Slightly more than 42% of the women examined were rural inhabitants, while about 58% lived in urban areas.

Table 3. The frequency of consumption of products in pregnancy.

	Urban area n (%)	Rural area n (%)	p
How often did you consume the below-mentioned products (concerns the period of the present pregnancy)?			
Meat			
Several times a day	193 (12.34)	122 (10.83)	<0.05
Several times a week	1,224 (78.26)	869 (77.11)	
Once a week or more rarely	118 (7.54)	122 (10.83)	
Once a month or more rarely	15 (0.96)	9 (0.80)	
Never	14 (0.90)	5 (0.44)	
Milk and dairy products (cheese, kefir, yogurt), eggs			
Several times a day	823 (52.29)	525 (45.89)	<0.05
Several times a week	672 (42.69)	538 (47.03)	
Once a week or more rarely	72 (4.57)	68 (5.94)	
Once a month or more rarely	5 (0.32)	11 (0.96)	
Never	2 (0.13)	2 (0.17)	
Raw and cooked salads			
Several times a day	514 (32.86)	296 (26.26)	<0.001
Several times a week	910 (58.18)	670 (59.45)	
Once a week or more rarely	125 (7.99)	140 (12.42)	
Once a month or more rarely	7 (0.45)	19 (1.69)	
Never	8 (0.51)	2 (0.18)	
Fruit			
Several times a day	1,142 (72.32)	747 (64.73)	<0.001
Several times a week	394 (24.95)	352 (30.50)	
Once a week or more rarely	36 (2.28)	48 (4.16)	
Once a moth or more rarely	2 (0.13)	5 (0.43)	
Never	5 (0.32)	2 (0.17)	
Sparkling and non-sparkling water			
Several times a day	1,332 (85.22)	902 (79.61)	<0.001
Several times a week	153 (9.79)	155 (13.68)	
Once a week or more rarely	43 (2.75)	42 (3.71)	
Once a month or more rarely	11 (0.70)	20 (1.77)	
Never	24 (1.54)	14 (1.24)	
Tea			
Several times a day	623 (40.40)	560 (49.91)	<0.001
Several times a week	578 (37.48)	375 (33.42)	
Once a week or more rarely	180 (11.67)	111 (9.89)	
Once a month or more rarely	71 (4.60)	39 (3.48)	
Never consumed	90 (5.84)	37 (3.30)	
Total (% of total)	1,542 (57.88)	1,122 (42.12)	2,664 (100)

As many as 64.08% of urban women and 56.31% of those from the rural environment changed their to-date diet in association with becoming pregnant ($p<0.05$) (Fig. 1, Tab. 2).

Every day, nearly all pregnant women had breakfast (97%), dinner (96%) and supper (92%). More than a half of the respondents also had a second breakfast (63%) and a light mid-afternoon meal (65%). Only approximately 3%

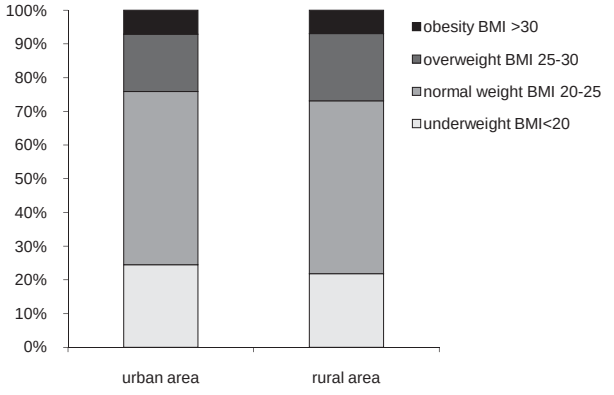

Figure 2. BMI before pregnancy.

of respondents each, in pregnancy, did not have second breakfasts and light mid-afternoon meals, or consumed these meals very rarely.

Considering the frequency of the meals consumed during the day, no significant differences were observed between rural and urban women. A detailed analysis showed no significant differences in the frequency of consumption of individual food products according to the place of residence with respect to sweets, fruit juice, sweetened beverages and coffee. Only about 2% of the respondents did not consume sweets when pregnant, whereas 15% of them ate sweets every day. Sweetened beverages were in the everyday diet of 13.7% of the expectant women, while coffee was consumed by 5.6%. 35.5% of the pregnant women limited sweetened beverages to a minimum, whereas 12% of respondents limited the consumption of coffee.

Life environment exerts a significant effect on the frequency of consumption in pregnancy of such products as meat, milk and dairy products, eggs, raw and cooked salads, fruits, tea and water.

While analyzing the data in Table 3 it should be presumed that meat was more often consumed in pregnancy by urban than rural women ($p<0.05$).

Almost 10% less of pregnant women from the rural areas consumed milk, dairy products, and eggs every day, compared to the urban inhabitants ($p<0.05$).

Pregnant women from the rural environment significantly more rarely consumed raw and cooked salads, fruits, and drank water, whereas they drank tea more frequently than urban women ($p<0.001$).

Nearly half of the expectant women had a taste preference for specific dishes in association with becoming pregnant (45.5%). Approximately 60% of the respondents reported that these were sour meals, 55% had a preference for sweet meals and confectionaries, and about 12% to salty meals.

Based on the BMI index, it was confirmed that before pregnancy a similar percentage of women from rural and urban areas were underweight (21.8% and 24.5%, respectively), overweight (19.9% and 17%, respectively), and obese (6.9% and 7.1%, respectively). As many as 51.3%

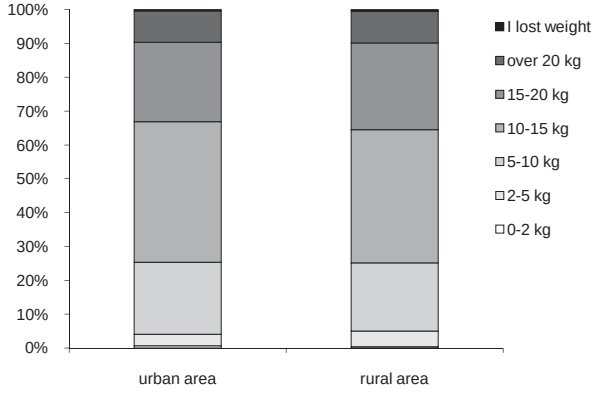

Figure 3. Weight gain during pregnancy.

of both rural and urban women had normal weight before becoming pregnant (Fig. 2).

No significant difference in the increase in body mass in pregnancy was noted between rural and urban women. The largest group of respondents from both environments (approx. 40%) gained weight from 10–15 kg, every fourth pregnant woman gained from 15–20 kg, every fifth gained from 5–10 kg, and in about 9% of respondents pregnancy weight gain was over 20 kg (Fig. 3).

DISCUSSION

In the presented study, over 60% of respondents declared a change of diet in pregnancy. According to the expectant women in the study, the changes in diet consisted in a more frequent consumption of white meat, fish, fruits and vegetables, and more frequent consumption of milk and dairy products. A significantly larger percentage of women living in the urban areas, compared to the rural inhabitants, increased the amount of fish and plant oils consumed. The environment of life also has a significant effect on the frequency of consumption of such products as meat, milk and dairy products, eggs, raw and cooked salads, fruit, tea and water. In own studies, favourable changes in the diet were more often observed among pregnant women from urban areas, compared to those living in rural areas.

According to the studies by British researchers, in pregnancy, an increase was observed in the consumption of white bread, breakfast cereals, cakes, processed meat, chips, fruit and fruit juices, sweets, hot chocolate, cream, cheese, polyunsaturated fats and oils, lettuce, red meat and non-alcoholic beverages, whereas a decrease was noted in the consumption of rice and pasta, giblets, vegetables, nuts, diet coke, coffee and tea, boiled potatoes and crackers [9].

Among pregnant women examined by Pinto *et al.*, the mean daily consumption of milk and dairy products in pregnancy was nearly twice as high as before pregnancy. The consumption of fats, breadstuff, fruit and soups also increased considerably in pregnancy, while the consumption of eggs, red meat, rice, pasta and potatoes, 'fast food' products, alcoholic beverages, coffee and tea, significantly decreased. In the 2 periods analyzed, no statistically significant differences were noted in the consumption of fish, vegetables, sweets, non-alcoholic beverages, and fruit juices. The daily number of meals in pregnancy increased up to 5 meals daily, from 54% before pregnancy to 71.5% [20].

In the studies by Bojar *et al.*, pregnant women, apart from increasing the amount of the products consumed after becoming pregnant, also changes their proportions. A decrease was observed in the amount of fruits consumed, with relation to the remaining food products, whereas an increase was noted in the percentage of meat, vegetables and cereal products in the diet applied [7].

The greatest majority of women changed their preferences with respect to cereal products (59.66% – positively, 31.93% – negatively). Pregnancy was more often the cause of negative than positive changes in the mode of nutrition in the case of vegetables (15.97% – positively, 27.73% – negatively) and fruits (18.49% and 45.38%), while an opposite situation was noted with respect to the consumption of dairy products (29.41% and 23.53%). The place of residence of the expectant mothers exerted a significant effect on the change in the amount of fruits consumed, in relation to other products and frequency of consumption of vegetables. Contrary to own studies, among the respondents living in the urban areas, higher percentages of negative changes were noted concerning the amount and frequency of consumption of vegetables and fruits, compared to pregnant rural women [7].

Studies conducted among pregnant women in Italy confirmed that from the second trimester of pregnancy until delivery the nutritional habits of expectant women, both qualitative and quantitative, were non-rational, and knowledge of this problem is poor. The patients consumed excessive amounts of highly calorific products and saturated fats, while their intake of dairy products and vegetables was insufficient. Food products consumed by the pregnant women increased the risk of occurrence of vitamin deficiency, especially folic acid and riboflavin [11, 12].

Spanish researchers noted that the consumption of food products and microelements in their country differs slightly before conception and during pregnancy. In pregnancy, the consumption of milk, fruits and vegetables increases, while the intake of sugar and alcohol decreases [2].

Finnish studies confirmed that pregnant women consume more microelements (by 30–40%) than recommended by the WHO – too much pork, margarine, citrus fruits and giblets [10].

American studies [6] show that the diet of a considerable part of the population of women at reproductive age does not cover the demand for microelements and vitamins, according to the established recommendations.

Women living in rural areas in China, at the third trimester of pregnancy, consumed an insufficient amount of the majority of nutrients in their diet, including those especially important during pregnancy, such as iron, zinc, riboflavin and folic acid [8].

CONCLUSIONS

More than a half of Polish women change their diet in pregnancy. According to the opinions of expectant mothers examined, these changes consist in a more frequent consumption of white meat, fish, fruit and vegetables, as well as milk and dairy products. Favourable changes in the diet were observed primarily among the respondents from the rural environment.

Due to an insufficient awareness of women at reproductive age of nutritional behaviours, the education of pregnant women and those who plan pregnancy concerning an adequate diet should be carried out by medical circles, schools and the media, and directed primarily towards women from the rural environment.

REFERENCES

1. Anderson AS: Pregnancy as a time for dietary change. *Proc Nutr Soc* 2001, **60**, 497–504.
2. Arija V, Cuco G, Vila J, Iranzo R, Fernandez-Ballart J: Food consumption, dietary habits and nutritional status of the population of Reus: follow-up from preconception throughout pregnancy and after birth. *Med Clin (Barc)* 2004, **123**, 5–11.
3. Barker DJ, Eriksson JG, Forsen T, Osmond C: Fetal origins of adult disease: strength of effects and biological basis. *Int J Epidemiol* 2002, **31**, 1235–1239.
4. Barker DJP: Foetal origins of coronary heart disease. *BMJ* 1995, **311**, 171–174.
5. Barker DPP: *Fetal and Infant Origins of Adult Disease*. BMJ Publishing Group, London 1993.
6. Bodnar LM, Siega-Riz AM: A Diet Quality Index for Pregnancy detects variation in diet and differences by sociodemographic factors. *Public Health Nutr* 2002, **5**, 801–809.
7. Bojar I, Wdowiak L, Humeniuk E, Błaziak P: Change in the quality of diet during pregnancy in comparison with WHO and EU recommendations – environmental and sociodemographic conditions. *Ann Agric Environ Med* 2006, **13**, 281–287.
8. Cheng Y, Dibley MJ, Zhang X, Zeng L, Yan H: Assessment of dietary intake among pregnant women in a rural area of western China. *BMC Public Health* 2009, **9**, 222.
9. Crozier SR, Robinson SM, Godfrey KM, Cooper C, Inskip HM: Women's dietary patterns change little from before to during pregnancy. *J Nutr* 2009, **139**, 1956–1963.
10. Erkkola M, Karppinen M, Javanainen J, Rasaneu L, Knip M, Virtanen SM: Validity and reproducibility of food frequency questionnaire for pregnant Finnish women. *Am J Epidemiol* 2001, **154**, 466–476.
11. Fidanza AA, Fidanza R: A nutrition study involving a group of pregnant women in Assisi, Italy. Part 1: Anthropometry, dietary intake and nutrition knowledge, practices and attitudes. *Int J Vitam Nutr Res* 1986, **56**, 373–380.
12. Fidanza AA, Simonetti MS, Cucchia LM: A nutrition study involving a group of pregnant women in Assisi, Italy. Part 2: Determination of vitamin nutriture. *Int J Vitam Nutr Res* 1986, **56**, 381–386.
13. Frederick I, Williams M, Dashow E, Kestin M, Zhang C, Leisenring W: Dietary fiber, potassium, magnesium and calcium in relation to the risk of preeclampsia. *J Reprod Med* 2005, **50**, 332–344.
14. Godfrey KM: Materna regulation of fetal development and Heath In adult life. *Eur J Obstet Gynecol Reprod Biol* 1998, **78**, 141–150.
15. Hakes CN, Barker DJ, Clark PM, Cox LJ, Fall C, Osmond C, Winter PD: Foetal and infant growth and impaired glucose tolerance at age 64. *BMJ* 1991, **303**, 1019–1022.
16. *Healthy Food and Nutrition for Women and their Families*. Training Course for Health Professionals. WHO. Regional Office for Europe. Regional Office for Unicef. Geneva, Central and Eastern Europe and the Commonwealth of Independent States and the Baltics.
17. Ladipo OA: Nutrition in pregnancy: mineral and vitamin supplements. *Am J Clin Nutr* 2000, **72(1 Suppl)**, 280–290.
18. *Nutrition During Pregnancy: Part I: Weight Gain, Part II: Nutrient Supplements* (1990), Committee on Nutritional Status During Pregnancy and Lactation, Institute of Medicine, National Academy of Sciences. Available from: http://www.nap.edu/catalog/1451.html
19. Olafsdottir A, Skuladottir G, Thorsdottir I, Hauksson A, Thorgeirsdottir H, Steingrimsdottir L: Relationship between high consumption of marine fatty acids in early pregnancy and hypertensive disorders in pregnancy. *BJOG* 2006, **113**, 301–309.
20. Pinto E, Barros H, Silva I: Dietary intake and nutritional adequacy prior to conception and during pregnancy: a follow-up study in the north of Portugal. *Public Health Nutr* 2009, **12**, 922–931.
21. Rasmussen KM, Yaktine AL: Weight Gain During Pregnancy: Reexamining the Guidelines, Food and Nutrition Board (FNB), Board on Children, Youth and Families (BOCYF) The National Academies Press, Washington, D.C. 2009. Available from: www.nap.edu.
22. Szostak-Węgierek D, Cichocka A: *Żywienie Kobiet w Ciąży*. PZWL, Warsaw 2005.
23. Yasmin S, Osrin D, Paul E, Costello A: Neonatal mortality of low birth-weight infants in Bangladesh. *Bull World Health Org* 2001, **79**, 608–614.
24. Yip R: Iron. **In:** Bowman BA, Russell RM (Eds): *Present Knowledge in Nutrition*. ILSI Press, Washington, DC 2001.