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# NUTRITIONAL KNOWLEDGE OF PREGNANT WOMEN FROM KRAKÓW. PART 3. RICH SOURCES OF VITAMINS AND MINERALS<sup>1)</sup>

**Agnieszka Marzęcka<sup>1</sup>, \*Wojciech Chalcarz<sup>2</sup>, Sylwia Merkiel<sup>2</sup>,  
Natalia Popierz-Rydlawska<sup>2</sup>, Renata Godyń-Swędzioł<sup>1</sup>**

<sup>1</sup>Gabriel Narutowicz City Specialist Hospital in Kraków

Director: dr n. med. Renata Godyń-Swędzioł

<sup>2</sup>Food and Nutrition Department of the Eugeniusz Piasecki University School of Physical Education in Poznań

Head of the Department: dr hab. Wojciech Chalcarz, prof. nadzw. AWF

## Summary

**Aim.** The aim of this study was to assess knowledge about rich sources of vitamins and minerals in pregnant women from Kraków.

**Material and methods.** Questionnaires on the knowledge about rich sources of vitamins and minerals were filled in by 115 pregnant women who were admitted to Gabriel Narutowicz City Specialist Hospital in Kraków. Statistical analysis was carried out by means of the IBM SPSS Statistics 19. The studied population was divided according to the trimester of pregnancy.

**Results.** Statistically significant differences were found for the answers to seven questions. The women in the second trimester of pregnancy gave the most correct answers to as many as six of these questions, as well as to the remaining questions, statistically insignificant.

**Conclusions.** The level of nutritional knowledge in the studied pregnant women was varied and similar to the level observed in the populations studied previously. Most probably, the major factor which influences nutritional knowledge of pregnant women is not education, but the duration of pregnancy, the necessity to adapt to new conditions, and whether the pregnancy had been planned.

Key words: nutritional knowledge, pregnancy, vitamins, minerals, women, Kraków

## INTRODUCTION

The condition of a pregnant woman and the growing foetus is influenced to a large degree by the woman's dietary intake. A pregnant woman should follow a balanced diet to provide adequate intake of all the essential nutrients. Adequate intake of vitamins and minerals is particularly important due to a high metabolic rate during pregnancy (1, 2). Deficient intake of some vitamins and minerals may be the cause of congenital defects, growth inhibition, low birth weight and growth retardation in foetus. However, excessive intake is also adverse, because it may disturb homeostasis or even be toxic (3).

At the highest risk of vitamin deficiency during pregnancy are females under the age of 16, as well as women who suffer from uncontrollable vomiting, women who smoke, drink alcohol or use other stimulants,

suffer from chronic diseases, were underweight before getting pregnant and have low socio-economic status (3). These women need vitamin, and in some cases mineral, supplementation. Vitamin supplementation is recommended also to pregnant women whose medical history revealed risk factors, for example hypertension, diabetes, pre-eclampsia during previous pregnancy and multiple pregnancy (4, 5).

Pregnant women should know which foodstuffs are rich sources of vitamins and minerals and that during pregnancy, puerperium and lactation, the requirement for some of these nutrients increases.

## AIM

The aim of this study was to assess knowledge about rich sources of vitamins and minerals in pregnant women from Kraków.

<sup>1)</sup>The study was carried out as a part of the grant: "Assessment of dietary intake and nutritional status of pregnant women, nutritional education – preventing cardiovascular diseases in mother and child" financed by the city council of Kraków.

## MATERIAL AND METHODS

Questionnaires on the knowledge about rich sources of vitamins and minerals were filled in by 115 pregnant women who were admitted to Gabriel Narutowicz City Specialist Hospital in Kraków. For this purpose, a questionnaire from our previous studies was adapted (6-11). Characteristics of the studied pregnant women were given in our previous article (12).

This study was approved by the Bioethics Committee of the Poznan University of Medical Sciences.

Statistical analysis was carried out by means of the IBM SPSS Statistics 19. The studied population was divided according to the trimester of pregnancy. Qualitative variables were presented in contingency tables. Statistical significance was determined using Pearson's chi-square test, except for the variables with more than 20% of cells with an expected frequency of less than five. In this case, the Kruskal-Wallis *H* test was used. The level of significance was set at  $p \leq 0.05$ .

## RESULTS

Table 1 shows the studied pregnant women's correct answers to the questions concerning rich dietary sources of vitamin A according to the trimester of pregnancy. Statistically significant differences were found for the answers to four questions: whether meat and meat products, fish, milk and dairy products, and animal fat are rich dietary sources of vitamin A. Post hoc tests did not show statistically significant differences between the pairs of trimesters. To all of these questions, the highest percentages of correct answers were given by the women in the second trimester. The percentages of cor-

rect answers ranged from 12.0%, in case of the question whether fish is a rich source of vitamin A, to 24.0%, in case of the question whether animal fat is a rich source of vitamin A.

Table 2 shows the studied pregnant women's correct answers to the questions concerning rich dietary sources of B vitamins according to the trimester of pregnancy. No statistically significant differences were observed. The women in the second trimester of pregnancy gave the highest percentages of correct answers to six questions.

Table 3 shows the studied pregnant women's correct answers to the questions concerning rich dietary sources of vitamin C according to the trimester of pregnancy. No statistically significant differences were observed. The women in the third trimester of pregnancy gave the highest percentages of correct answers to five questions.

Table 4 shows the studied pregnant women's correct answers to the questions concerning rich dietary sources of calcium according to the trimester of pregnancy. No statistically significant differences were observed. The women in the second trimester of pregnancy gave the highest percentages of correct answers to six questions, whereas the percentages of correct answers in women in the first trimester were the lowest in case of all of the questions.

Table 5 shows the studied pregnant women's correct answers to the questions concerning rich dietary sources of iron according to the trimester of pregnancy. Statistically significant differences were found for the answers to three questions: whether poultry, fish and milk and dairy products are rich sources of iron.

Table 1. The studied pregnant women's correct answers to the questions concerning rich dietary sources of vitamin A according to the trimester of pregnancy. Results given in [%].

| No. | Correct answers   | Trimester of pregnancy |                   |                  | All women (n=115) |
|-----|---|------------------------|-------------------|------------------|-------------------|
|     |   | The first (n=14)       | The second (n=75) | The third (n=26) |                   |
| 1.  | Meat and meat products are not rich sources of vitamin A*           | 7.1                    | <b>13.3</b>       | <b>3.8</b>       | 10.4              |
| 2.  | Poultry is not a rich source of vitamin A                           | 7.1                    | 14.7              | 3.8              | 11.3              |
| 3.  | Fish is not a rich source of vitamin A*                             | <b>0.0</b>             | <b>12.0</b>       | <b>7.7</b>       | 9.6               |
| 4.  | Sweets are not rich sources of vitamin A                            | 28.6                   | 46.7              | 46.2             | 44.3              |
| 5.  | Milk and dairy products are rich sources of vitamin A*              | <b>0.0</b>             | <b>22.7</b>       | <b>15.4</b>      | 18.3              |
| 6.  | Animal fat is not a rich source of vitamin A*                       | <b>7.1</b>             | <b>24.0</b>       | <b>7.7</b>       | 18.3              |
| 7.  | Plant oils are not rich sources of vitamin A                        | 14.3                   | 14.7              | 11.5             | 13.9              |
| 8.  | Nuts, almonds, soya bean and bran are not rich sources of vitamin A | 14.3                   | 10.7              | 11.5             | 11.3              |
| 9.  | Blackcurrants and strawberries are not rich sources of vitamin A    | 0.0                    | 16.0              | 15.4             | 13.9              |
| 10. | Wholemeal bread is not a rich source of vitamin A                   | 21.4                   | 16.0              | 7.7              | 14.8              |

Bold type denotes statistical significance at  $p \leq 0.05$ .

\*Post hoc tests did not show statistically significant differences between the pairs of trimesters.

The answers given by the women in the first trimester of pregnancy to the question whether poultry is a rich source of iron differed statistically significantly from the answers given by the women in the second and the third trimester, 7.1%, 50.7% and 46.2%, respectively. The answers given by the women in the first trimester of pregnancy to the question whether fish is a rich source of iron differed statistically significantly from the answers given by the women in the second trimester, 14.3% vs

49.3%, and to the question whether milk and dairy products are rich sources of this mineral, the answers given by the women in the first trimester differed statistically significantly from the answers given by the women in the third trimester, 21.4% vs 65.4%.

#### DISCUSSION

The comparison of the range of correct answers, given by the women in each trimester of pregnancy, to the

Table 2. The studied pregnant women's correct answers to the questions concerning rich dietary sources of B vitamins according to the trimester of pregnancy. Results given in [%].

| No. | Correct answers   | Trimester of pregnancy |                   |                  | All women (n=115) |
|-----|---|------------------------|-------------------|------------------|-------------------|
|     |   | The first (n=14)       | The second (n=75) | The third (n=26) |                   |
| 1.  | Meat and meat products are rich sources of B vitamins             | 28.6                   | 37.3              | 30.8             | 34.8              |
| 2.  | Poultry is a rich source of B vitamins                            | 21.4                   | 44.0              | 23.1             | 36.5              |
| 3.  | Fish is a rich source of B vitamins                               | 28.6                   | 44.0              | 38.5             | 40.9              |
| 4.  | Sweets are not rich sources of B vitamins                         | 64.3                   | 72.0              | 76.9             | 72.2              |
| 5.  | Milk and dairy products are rich sources of B vitamins            | 14.3                   | 36.0              | 23.1             | 30.4              |
| 6.  | Animal fat is not a rich source of B vitamins                     | 42.9                   | 36.0              | 26.9             | 34.8              |
| 7.  | Plant oils are not rich sources of B vitamins                     | 14.3                   | 26.7              | 19.2             | 23.5              |
| 8.  | Nuts, almonds, soya bean and bran are rich sources of B vitamins  | 57.1                   | 52.0              | 34.6             | 48.7              |
| 9.  | Blackcurrants and strawberries are not rich sources of B vitamins | 7.1                    | 24.0              | 11.5             | 19.1              |
| 10. | Wholemeal bread is a rich source of B vitamins                    | 57.1                   | 50.7              | 34.6             | 47.8              |

Table 3. The studied pregnant women's correct answers to the questions concerning rich dietary sources of vitamin C according to the trimester of pregnancy. Results given in [%].

| No. | Correct answers   | Trimester of pregnancy |                   |                  | All women (n=115) |
|-----|---|------------------------|-------------------|------------------|-------------------|
|     |   | The first (n=14)       | The second (n=75) | The third (n=26) |                   |
| 1.  | Meat and meat products are not rich sources of vitamin C            | 28.6                   | 50.7              | 50.0             | 47.8              |
| 2.  | Poultry is not rich a source of vitamin C                           | 28.6                   | 48.0              | 50.0             | 46.1              |
| 3.  | Fish is not rich a source of vitamin C                              | 28.6                   | 49.3              | 50.0             | 47.4              |
| 4.  | Sweets are not rich sources of vitamin C                            | 57.1                   | 58.7              | 57.7             | 58.3              |
| 5.  | Milk and dairy products are not rich sources of vitamin C           | 42.9                   | 48.0              | 50.0             | 47.8              |
| 6.  | Animal fat is not rich a source of vitamin C                        | 21.4                   | 50.7              | 50.0             | 47.0              |
| 7.  | Plant oils are not rich sources of vitamin C                        | 21.4                   | 38.7              | 42.3             | 37.4              |
| 8.  | Nuts, almonds, soya bean and bran are not rich sources of vitamin C | 35.7                   | 29.3              | 34.6             | 31.3              |
| 9.  | Blackcurrants and strawberries are rich sources of vitamin C        | 64.3                   | 86.7              | 88.5             | 84.3              |
| 10. | Wholemeal bread is not rich a source of vitamin C                   | 21.4                   | 40.0              | 23.1             | 33.9              |

Table 4. The studied pregnant women's correct answers to the questions concerning rich dietary sources of calcium according to the trimester of pregnancy. Results given in [%].

| No. | Correct answers   | Trimester of pregnancy |                   |                  | All women (n=115) |
|-----|---|------------------------|-------------------|------------------|-------------------|
|     |   | The first (n=14)       | The second (n=75) | The third (n=26) |                   |
| 1.  | Meat and meat products are not rich sources of calcium            | 28.6                   | 34.7              | 38.5             | 34.8              |
| 2.  | Poultry is not a rich source of calcium                           | 28.6                   | 34.7              | 34.6             | 33.9              |
| 3.  | Fish is not a rich source of calcium                              | 14.3                   | 29.3              | 26.9             | 27.0              |
| 4.  | Sweets are not rich sources of calcium                            | 57.1                   | 66.7              | 61.5             | 64.3              |
| 5.  | Milk and dairy products are rich sources of calcium               | 78.6                   | 86.7              | 96.2             | 87.8              |
| 6.  | Animal fat is not a rich source of calcium                        | 21.4                   | 48.0              | 34.6             | 41.7              |
| 7.  | Plant oils are not rich sources of calcium                        | 21.4                   | 49.3              | 38.5             | 43.5              |
| 8.  | Nuts, almonds, soya bean and bran are not rich sources of calcium | 28.6                   | 29.3              | 30.8             | 29.6              |
| 9.  | Blackcurrants and strawberries are not rich sources of calcium    | 28.6                   | 45.3              | 38.5             | 41.7              |

Table 5. The studied pregnant women's correct answers to the questions concerning rich dietary sources of iron according to the trimester of pregnancy. Results given in [%].

| No. | Correct answers   | Trimester of pregnancy   |                         |                         | All women (n=115) |
|-----|---|--------------------------|-------------------------|-------------------------|-------------------|
|     |   | The first (n=14)         | The second (n=75)       | The third (n=26)        |                   |
| 1.  | Meat and meat products are rich sources of iron             | 50.0                     | 69.3                    | 80.8                    | 69.6              |
| 2.  | Poultry is a rich source of iron                            | <b>7.1<sup>a,b</sup></b> | <b>50.7<sup>a</sup></b> | <b>46.2<sup>b</sup></b> | 44.3              |
| 3.  | Fish is a rich source of iron                               | <b>14.3<sup>a</sup></b>  | <b>49.3<sup>a</sup></b> | <b>34.6</b>             | 41.7              |
| 4.  | Sweets are not rich sources of iron                         | 35.7                     | 60.0                    | 73.1                    | 60.0              |
| 5.  | Milk and dairy products are not rich sources of iron        | <b>21.4<sup>a</sup></b>  | <b>46.7</b>             | <b>65.4<sup>a</sup></b> | 47.8              |
| 6.  | Animal fat is not a rich source of iron                     | 14.3                     | 36.0                    | 38.5                    | 33.9              |
| 7.  | Plant oils are not rich sources of iron                     | 21.4                     | 35.1                    | 46.2                    | 36.0              |
| 8.  | Nuts, almonds, soya bean and bran are rich sources of iron  | 35.7                     | 42.7                    | 38.5                    | 40.9              |
| 9.  | Blackcurrants and strawberries are not rich sources of iron | 0.0                      | 29.3                    | 34.6                    | 27.0              |
| 10. | Wholemeal bread is a rich source of iron                    | 14.3                     | 26.7                    | 23.1                    | 24.3              |

Bold type denotes statistical significance at  $p \leq 0.05$ . The same superscript letters denote statistically significant differences between the pairs of trimesters at  $p \leq 0.05$ .

questions concerning rich dietary sources of vitamins and minerals shows that the most difficult was recognising rich sources of vitamin A.

This vitamin is contained in foodstuffs of both animal and plant origin. In animal products, the main form of vitamin A is retinol and its derivatives, whereas in plant products – only provitamins A (carotenes). It should be emphasised that carotene may also be contained in foodstuffs of animal origin. The richest source of vitamin A is cod liver oil, offal,

especially liver, but not meat and meat products or poultry. Rich sources of this vitamin are also some species of sea fish, such as eel or tuna, eggs, butter, margarines fortified with vitamin A and hard cheese, but not lard or pork fat. Very good sources of provitamin A are vegetables, such as carrot, red pepper, pumpkin, string bean, and fruit, such as apricots and peaches. Therefore, among the foodstuffs in table 1, only milk and dairy products may be considered rich sources of vitamin A (13).

Vitamin A plays an important role in vision, is necessary to keep good condition of mucous membranes and skin, is crucial to tissue growth, cell differentiation, reproduction and the immune system. The transfer of vitamin A to foetus is limited by the placenta. Therefore, vitamin A concentration in foetus is lower than in the mother. Excessive intake of this vitamin may cause congenital defects in the foetus, such as the higher risk of hydrocephalus, microcephaly or the defects of facial skeleton, heart or central nervous system. Deficiencies of vitamin A during pregnancy may increase the risk of eclampsia, impairment of the intrauterine growth, preterm rupture of the foetal membranes, as well as low birth weight (14, 15, 16, 17). That is why using  $\beta$ -carotene supplementation in pregnant women is safer, because this precursor of vitamin A is characterised by lower biological activity (14).

The percentages of correct answers given by the studied women to questions concerning rich sources of vitamin A ranged from 0.0%, in case of the women in the first trimester who did not know that milk and dairy products are rich sources of this vitamin (13) and that neither fish nor blackcurrants and strawberries are rich sources of vitamin A (13), to 46.7%, in case of the women in the second trimester who knew that sweets are not a rich source of vitamin A (13). The highest level of knowledge about rich dietary sources of vitamin A was observed in the women in the second trimester of pregnancy.

The questions concerning rich dietary sources of vitamin A were also difficult for the preschool staff from Nowy Sącz and the vicinity, with the range of correct answers from 4.8% to 53.3% (10), for the parents of preschool children from Pabianice, with the range of correct answers from 5.9% to 57.6% (18), as well as for the parents of preschool children from Nowy Sącz and the vicinity, with the range of correct answers from 6.3% to 51.8% (9). Much higher level of knowledge was observed in the kayakers and Canadian canoeists from Poznań, with the range of correct answers from 7.5% to 98.2% (11).

The percentages of correct answers given by the studied women to the questions concerning rich sources of B vitamins ranged from 7.1% in case of the answers given by the women in the first trimester to the question whether blackcurrants and strawberries are rich sources of B vitamins, to 76.9% in case of the answers given by the women in the third trimester to the question whether sweets are rich sources of B vitamins. The highest level of knowledge about rich dietary sources of B vitamins was observed in the women in the second trimester of pregnancy. Higher level of knowledge in this field was found only in the kayakers and Canadian canoeists from Poznań, because the range of correct answers ranged from 7.5% to 96.2% (11). The percentages of correct answers in the preschool staff from Nowy Sącz and the vicinity ranged from 0.0% to 71.4% (10), in the parents of preschoolers from Pabianice – from 13.0% to 66.9% (18), and in the

parents of preschoolers from Nowy Sącz and the vicinity – from 17.2% to 64.3% (9).

Meat and meat products, poultry, fish, milk and dairy products, soya bean, bran and wholemeal bread are known to be rich sources of B vitamins (13, 19). When comparing the nutrient content of foodstuffs in the recent food composition tables (13), it is obvious that also nuts and almonds are rich sources of these vitamins (9). However, blackcurrants and strawberries cannot be considered rich sources of B vitamins (9). According to Polish experts' position (14), all women during the pre-conception period and during the first and the second trimester of pregnancy should use folic acid supplements (14). Women who follow a vegan diet should use vitamin B12 supplements (20, 21).

The easiest for the studied pregnant women were the questions concerning rich dietary sources of vitamin C and calcium. The percentages of correct answers given by the studied women to the questions concerning rich sources of vitamin C ranged from 21.4%, in case of the answers given by the women in the first trimester to the questions whether animal fat, plant oils and wholemeal bread are rich sources of this vitamin, to 88.5% in case of the answers given by the women in the third trimester to the question whether blackcurrants and strawberries are rich sources of vitamin C. The percentages of correct answers given by the studied women to the questions concerning rich sources of calcium ranged from 14.3%, in case of the answers given by the women in the first trimester to the question whether fish is a rich source of calcium, to 96.2% in case of the answers given by the women in the third trimester to the question whether milk and dairy products are rich sources of this mineral. The highest level of knowledge about rich dietary sources of vitamin C was observed in the women in the third trimester of pregnancy, and in case of calcium – the women in the second trimester.

A bit higher level of knowledge about rich dietary sources of vitamin C, in comparison to the studied pregnant women, was observed in the parents of preschool children from Pabianice, with the range of correct answers from 21.7% to 93.1% (18), and the parents of preschool children from Nowy Sącz and the vicinity, with the range of correct answers from 25.0% to 93.8% (9). The percentages of correct answers given by the preschool staff from Nowy Sącz and the vicinity ranged from 0.0% to 96.7% (10) and in case of the kayakers and Canadian canoeists from Poznań – from 14.5% to 100.0% (11). The level of knowledge in the studied pregnant women about rich dietary sources of calcium was slightly higher than in female basketball players, with the range of correct answers from 7.1% to 85.7% (7), the preschool staff from Nowy Sącz and the vicinity, with the range of correct answers from 0.0% to 97.0% (10), the parents of preschool children from Pabianice, with the range of correct answers from 18.9% to 89.0% (18), as well as the parents of preschool children from Nowy Sącz and the vicinity, with the range of correct answers from 7.8% to 93.8% (9). The best knowledge in this field

was observed in the kayakers and Canadian canoeists from Poznań, with the range of correct answers from 73.6% to 98.2% (11).

Vitamin C is an antioxidant which protects muscle tissue from damages caused by oxidative stress (22). Together with vitamin E, these antioxidants probably play an important role in the prevention of preterm rupture of the foetal membranes (23). Vitamin C increases non-haem iron absorption in the intestine. This vitamin is contained in plant products, with its highest content in wild rose fruit, blackcurrants, strawberries, citrus fruit and in cruciferous vegetables (13, 19). It is more and more often added to various foodstuffs. Polish experts do not recommend vitamin C supplementation during pregnancy (14).

Calcium plays a very important role in the diets of pregnant women. It is used in the prevention of pre-eclampsia because of its influence on the normalisation of blood pressure. Requirement for this mineral increases during the second and the third trimester of pregnancy and during lactation. Absorption of calcium in the intestine is influenced by the presence of vitamin D, organic acids, lactose, non-digestible oligosaccharides, oxalates and phytates. Excessive calcium loss may be caused by high animal protein, salt and coffee intake. Maintaining optimal proportion between calcium and phosphorus concentration prevents bone tissue resorption. Using calcium supplementation along with providing adequate vitamin D metabolism, increases calcium bioavailability. The risk of calcium deficiency is greater in persons not exposed to sunlight, in multiparas and in breast feeding women (14).

The richest source of highly bioavailable dietary calcium is milk and dairy products (13). Other products included in table 4 either are not the source of calcium or only in special cases may be significant sources of this mineral (19).

The percentages of correct answers given by the studied women to the questions concerning rich sources of iron ranged from 0.0% in case of the answers given by the women in the first trimester to the question whether blackcurrants and strawberries are rich sources of this mineral, to 80.0% in case of the answers given by the women in the third trimester to the question whether meat and meat products are rich sources of iron.

The level of knowledge, in the studied pregnant women, about rich dietary sources of iron was higher than in female basketball players, whose range of correct answers was from 0.0% to 64.3% (8), and a bit lower than in the preschool staff from Nowy Sącz and the vicinity, with the range of correct answers from 0.0% to 81.8% (10). The percentages of correct answers among the parents of preschoolers from Pabianice ranged from 15.9% to 69.5% (18), and in the parents of preschoolers from Nowy Sącz and the vicinity – from 15.6% to 67.2% (9). The percentages of correct answers given by the kayakers and Canadian canoeists from Poznań ranged from 3.6% to 96.2% (11).

The best sources of iron are first of all meat and meat products, poultry and fish, but also nuts, almonds, soya bean, bran and wholemeal bread (13). It should be emphasised that non-haem iron, that is iron contained in plant products, is of much lower bioavailability to human organism (19). Iron supplementation should be used in women with anaemia during the preconception period and should be introduced once again after the eighth week of pregnancy. Iron supplementation is recommended to pregnant women with anaemia or who are at risk of anaemia. It is also advised to continue iron supplementation during lactation because it decreases the risk of anaemia in children (14).

The level of nutritional knowledge in the studied pregnant women was varied and similar to the level observed in the populations studied previously. The percentages of correct answers were the lowest in the women in the first trimester of pregnancy, whereas in the women in the second trimester – the highest. Since among the group in the first trimester the percentages of women with both higher and secondary education were the highest (12), most probably education is not the major factor which influences nutritional knowledge of pregnant women, but rather the duration of pregnancy, the necessity to adapt to new conditions, and whether the pregnancy had been planned.

## CONCLUSIONS

1. The level of nutritional knowledge in the studied pregnant women was varied and similar to the level observed in the populations studied previously.
2. Most probably, the major factor which influences nutritional knowledge of pregnant women is not education, but the duration of pregnancy, the necessity to adapt to new conditions, and whether the pregnancy had been planned. □

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Correspondence to:

\*Wojciech Chalcarz

Zakład Żywności i Żywienia

Akademii Wychowania Fizycznego w Poznaniu

ul. Droga Dębińska 7, 61-555 Poznań

tel.: +48 (61) 835-52-87

e-mail: chalcarz@awf.poznan.pl