

# Assessment of the diet components of pregnant women as predictors of risk of preterm birth and born baby with low birth weight

Ocena składników diety kobiet ciężarnych jako czynnik predykcyjny porodu przedwczesnego i dziecka z niską masą urodzeniową

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## Abstract

**Objective:** The diet of pregnant women is an important factor in the development of the fetus. In our study, we wanted to determine the diet of women who gave birth to healthy children at term (AGA), preterm (PTB) and small for gestational age neonates (SGA). Based on the analysis of dietary components we wanted predict the likelihood of giving birth AGA, PTB and SGA.

**Methods:** The content of components in the women's diets were estimated based on the dietary questionnaire. The large number of variables analyzed in the diet was reduced using factor analysis. Next, the prediction of prematurity and SGA based on previously selected factors was analyzed. For this purpose, two independent methods were used: discriminant function analysis and ROC analysis.

**Results:** Factor analysis resulted in nine factors containing at least one variable of the factor load being greater than 0.7. Analysis of variance only showed differences between the AGA and preterm groups. The study of discriminant function showed that three factors significantly affect the discriminative power to classify cases into AGA and preterm groups. ROC analysis confirmed diagnostic usefulness factor 1 (fatty acids) in classifying cases into AGA and preterm groups.

**Conclusion:** Based on the analysis of dietary components of women one can predict the likelihood of giving birth to a healthy child at term and prematurely. For AGA the predicting factor is a higher content of short and medium chain fatty acids in a woman's diet.

Key words: **preterm birth / diet components / baby with low birth weight /**

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## Streszczenie

**Wstęp:** Dieta kobiet ciężarnych jest ważnym czynnikiem wpływającym na rozwój płodu. Celem niniejszych badań było określenie prawdopodobieństwa urodzenia zdrowego dziecka o czasie (AGA), przed czasem (PTB) oraz urodzenia dziecka z niską masą urodzeniową (SGA) na podstawie analizy diety kobiet ciężarnych.

**Metody:** Zawartość składników diety oceniano na podstawie kwestionariusza żywieniowego przygotowanego przez Instytut Żywności i Żywienia w Warszawie. Dużą liczbę analizowanych w diecie zmiennych zredukowano stosując analizę czynnikową, dzięki czemu wyłoniono czynniki najbardziej reprezentatywne, stosowane w dalszej części badań. Następnie, przeprowadzono analizę prognozy urodzenia dzieci AGA, PTB oraz SGA na podstawie wyłonionych czynników diety. W tym celu zastosowano dwie niezależne metody: analizę funkcji dyskryminacyjnej oraz analizę ROC.

**Wyniki:** Analiza czynnikowa wyłoniła 9 czynników zawierających przynajmniej jedną zmienną o wartości ładunku czynnikowego  $FL > 0.7$ . Analiza wariancji wykazała zróżnicowanie jedynie pomiędzy grupą AGA i PTB. Badanie funkcji dyskryminacyjnej dla 9 czynników wykazało, że trzy czynniki istotnie wpływają na moc dyskryminacyjną, klasyfikując przypadki do grupy AGA i PTB. Analiza ROC arbitralnie wybranego czynnika 1 potwierdziła jego przydatność diagnostyczną w klasyfikowaniu przypadków do grupy AGA i PTB.

**Wnioski:** Na podstawie analizy składników diety kobiet ciężarnych, można prognozować prawdopodobieństwo urodzenia dziecka zdrowego o czasie oraz przed czasem. Czynnikiem prognostycznym AGA jest większa zawartość kwasów krótko- i średniołańcuchowych w diecie kobiet.

Słowa kluczowe: **dieta kobiet ciężarnych / poród przedwczesny /  
/ niska masa urodzeniowa /**

## Introduction

The diet of pregnant women is considered to be one of the most important factors that influence the development of the child. This applies to both the intrauterine period, during which the ingredients contained in the mother's diet are transmitted through the placenta to the developing fetus, and the postpartum period when the ingredients contained in the mother's postnatal diet and those stored by the mother's body (mainly in adipose tissue) are substrates for the biosynthesis of milk in the mammary glands [1-4]. It is known that a poor diet in the mother, resulting in deficiency, excess or inappropriate proportions of key ingredients (such as fatty acids) can lead to numerous health problems in her children. The effects can be immediately visible post-childbirth and can manifest themselves in a low birth weight (regardless of gestational age), prematurity, intrauterine growth restriction, retardation of the nervous system and retina. In later years of life a reduced IQ index is observed [5, 6], as well as an increased risk of developing cardiovascular, metabolic and other diseases [4, 7, 8].

While it is relatively easy to analyze the impact of individual dietary components on the individual components of milk, the evaluation of the influence of diet understood as a collection of many ingredients on the composition of compounds found in milk is a complex task and difficult to interpret scientifically. Such analysis, however, gives a more complete picture of interactions in the milk-diet configuration and reveals a number of cross-interactions between substances contained in the diet and in the milk. So far, there have been many studies on the effects of diet on the composition of breast milk [9,10]. However, the diet-milk relationship of mothers who gave birth to a child at the interface between physiology and pathology, i.e. "late" preterm infants or full-term SGA neonates, has not yet been evaluated. It is

therefore not known whether a small degree of prematurity and SGA may be related to the mother's diet or whether the causes of prematurity, intrauterine malnutrition and low birth weight are associated with other factors such as abnormal function of the placenta, or indeed whether the problem is much more complex. If a mother's diet actually affects a child's development, these effects should be visible in minor disorders, such as giving birth to a child in the period of time immediately preceding 37 weeks of pregnancy and the birth of a full-term but small for gestational age (SGA) neonate. Perhaps then it is possible to identify these factors and predict prematurity, SGA and other irregularities based on the results of the study of pregnant women's diets. Our previous studies have shown that in both mothers and their children born with slight deviations from accepted norms, visible changes occur in the content of many components of maternal peripheral blood, umbilical cord blood [11] and the composition of transitional and mature milk produced by the mother [12]. Due to the fact that the above-mentioned changes concern the key compounds responsible for the development of the fetus and child (post-childbirth), it is likely that there are relationships between the biochemical composition of the diet and the condition of the newborn baby, having less to do with eating habits but with the consumption of specific compounds. Since we eat complex food, not single nutrients or food items, we should turn our analysis more towards dietary patterns, which may be a useful tool in explaining the complex relationship between the diet of pregnant women and giving birth to neonates of different condition. In these studies there are a large number of variables, making it difficult or even impossible to interpret the results correctly. In order to explain these relationships we used factor analysis in our study, which made it possible to reduce the number of variables tested and to detect structures in the relationships between

those variables. However, we rejected the usual approach to factor analysis of the diet, which typically involves analysis of specific product consumption. We focused instead on the study of individual dietary components such as specific fatty acids, vitamins, proteins etc. It seems that this approach to data analysis gives a more informative picture of the impact of diet on the physiology of pregnant women, breastfeeding mothers and the health condition of their children.

## Materials and methods

The study involved 98 women who gave birth in the Provincial Specialist Hospital in Tychy, Poland. Only 98 women met the criteria agreed upon before the start of the study. A relatively small and uneven number of women were accepted onto the study due to the fact that most of them did not meet the strict inclusion criteria. Women who agreed to participate in the study were classified into three groups:

1. Group AGA ( $n = 54$ ): healthy mothers, routine and uneventful pregnancy, delivery of full-term neonates (bw 10<sup>th</sup> - 90<sup>th</sup> percentile);
2. Group PTB ( $n = 32$ ): mothers who gave birth prematurely – between 35-37 weeks (bw 10<sup>th</sup>-90<sup>th</sup> percentile);
3. Group SGA ( $n = 12$ ): mothers who gave birth to full-term but small for gestational age neonates (bw <10<sup>th</sup> percentile) (Table 1).

In order to determine the regularity of pregnancy, the women were subjected to three ultrasound examinations, the first of which took place between the 12<sup>th</sup> and 14<sup>th</sup> weeks of gestation, the second between the 20<sup>th</sup> and 22<sup>nd</sup> weeks and the final one between the 32<sup>nd</sup> - 33<sup>rd</sup> weeks. During the last examination it was determined whether the child would be classified as AGA or SGA. Fetuses in utero with abdominal measurements below the 10<sup>th</sup> percentile of reference values were defined as SGA fetuses. SGA was confirmed at birth if the neonatal weight was below the 10<sup>th</sup> percentile. All the fetuses had normal karyotypes and no malformation at birth. The mothers did not receive any dietary supplementation during pregnancy. The mothers in Group PTB did not receive corticosteroids. Maternal age, BMI, neonatal weights, mode of delivery and Apgar scores are presented in Table 1. The children whose weight exceeded the 90<sup>th</sup> percentile (large for gestational age – LGA) were not included in the study.

The following inclusion criteria were taken into consideration when selecting women for the study:

1. Stable socioeconomic status.
2. Secondary or higher level of education.
3. Single pregnancy; pregnancy I - III.
4. Living in a highly industrialized urban area.
5. Following a typical diet for the Polish population (none of the women accepted onto the study were vegetarians, none of them followed any other special diet either).
6. Polish nationality (excluding naturalized Polish citizens).
7. Granting consent to participate in the study.

The following exclusion criteria were applied:

1. Chronic diseases.
2. Pathologies during the course of pregnancy, such as gestational high blood-pressure, infections during pregnancy, miscarriages and/or premature birth resulting in the death of the child or developmental

anomalies of the fetus.

3. AIDS and sexually transmitted diseases.
4. Lack of the mother's consent to take part in the research program or withdrawal of consent during the study.

The study was approved by the Bioethics Review Board of the Silesian University of Medicine in Katowice, Poland (L.dz. NN-6501-183/I/07), which is in accordance with the Declaration of Helsinki.

## Feeding questionnaire

The composition of the women's diet was estimated based on the dietary questionnaire designed by the National Food and Nutrition Institute in Warsaw, Poland. The questionnaire allowed the researchers to determine the daily consumption of each particular dietary component (proteins, carbohydrates, fats, fatty acids, vitamins) as well as the mother's calorie consumption over a one-month period. The questionnaire included a list of 124 products in the following food groups: milk and dairy products, eggs, meat, sausages, offal, fish, animal and vegetable fats, vegetables, fruit and fruit-products, potatoes and potato-based products, seeds, legumes, cereals and cereal-products, pre-cooked ready meals, salty snacks, nuts and grains, sugar and sweets, soft drinks, alcohol, soup concentrates, sauces and spices. The questionnaire was filled in by each mother three days after childbirth. The DIET FAO program, which includes data on 1,067 typical Polish dishes or food products, was used to estimate the quantity of the aforementioned components.

Before the research began every participant was clearly instructed and offered training on how to fill in the questionnaire, as well as how to record the volume or the mass of foods using standard household measures such as a spoonful, a glass etc. The mothers were not given any hints or tips on their diet. The mothers had to record how frequently they consumed each product, with the options being: daily, several times a week, once a week, 2-3 times a month and never. Dietary consumption was validated via the 'Food Intake Frequency Questionnaire', a 7-day nutritional survey. The method employed was to write down all the products and dishes that were consumed each day, for a period of 7 days. Food portion sizes were given in household measures, and in the case of some products, where possible, also in grams. Portion sizes were verified using the "Album of photographs of food products and dishes" [13].

## Statistics

Factor analysis was used to detect relationships between a number of variables obtained during the study of the mother's dietary components. The use of factor analysis meant it was possible to reduce the number of variables and to classify them. Subsequently, the most representative variables of the factors were identified. To study factor loadings (FL) it was decided to arbitrarily choose the variable within the factor which was the most effective means of measurement (which had a documented physiological role). If there was no factual basis for the selection of the most representative variable for the particular factor, the variable with the largest absolute value of the factor loading was then chosen (variables carrying the greatest load of information). In both cases, the following condition was satisfied: the absolute value of  $FL > 0.7$ . Next, discriminant function analysis was performed for all the factors in which variables of factor

loadings above 0.7 had been identified. The purpose of this part of the analysis was to develop a discriminant function qualifying mothers into groups AGA, PTB and SGA. The differences obtained between the studied groups for the relevant factors were treated as hypothetical risk factors for prematurity and reduced fetal growth. Subsequently ROC analysis was performed for those risk factors. Threshold values were set, above which the likelihood of premature birth or the birth of an SGA child was significantly increased. The odds ratio of exposure was calculated ( $OR_{exp}$ ), as well as relative risk (RR), sensitivity (True Positive Rate, TPR), specificity (True Negative Rate, TNR), positive predictive value (PPV), negative predictive value (NPV), and accuracy (ACC). The following are the formulas for calculating the above-mentioned values:

$$OR_{exp} = (TP \times TN) / (FN \times FP)$$

$$RR = [TP / (TP + FP)] / [FN / (FN + FP)]$$

$$TPR = TP / (TP + FN)$$

$$TNR = TN / (TN + FP)$$

$$PPV = TP / (TP + FP)$$

$$NPV = TN / (TN + FN)$$

$$ACC = (TN + TP) / (TP + TN + FP + FN)$$

TP – true positive, TN – true negative, FP – false positive, FN – false negative.

## Results

Based on the analysis of food consumed by pregnant women, 51 dietary components and parameters were specified, such as fats (including fatty acids), vitamins, proteins, carbohydrates, energy value, alcohol and others. These variables were subjected to factor analysis. 9 factors emerged out of the analysis, which included at least one variable with the absolute value of the factor load (FL) above 0.7 (factor load > 0.7). Table 2 shows only the variables whose absolute load value exceeded 0.7. The cumulative value of the variance of these factors was 90.93%. Variables with a value of more than 0.7 FL in factor 1 are saturated, short and medium-chain fatty acids (SSMCFA), which is why this factor was named SSMCFA. The variables selected in factor 2 are ascorbic acid and folic acid. We named this factor water-soluble vitamins (WSV). In factor 3 and factor 4, long-chain fatty acids were selected. Factor 3 mostly contained acids with 20 or more carbons, whereas in factor 4 essential fatty acids emerged among others – such as linoleic acid and linolenic acid. Factor 3 and factor 4 were named respectively LCPUFA (long polyunsaturated fatty acid) and EFA (essential fatty acid). In factor 5, two variables exceeded the value of 0.7 factor load. They were the percentage of energy obtained from carbohydrates, and the percentage of energy obtained from fat. This factor was named Energy. In factor 6 two other variables were also selected: vitamin A and beta-carotene - the factor was named Vitamin A. In each of the last three factors (7-9) one variable was selected: lactose, alcohol and animal protein, respectively.

In the next stage of the research, analysis of variance was carried out, revealing differences between groups AGA and PTB (data not shown) only. Based on the results of the analysis of variance in the later stages, the only differentiation examined was the one between the group of mothers who gave birth at term and the mothers who gave birth prematurely. Subsequent stages of the study did not include elements of the diet of those mothers whose children were small for gestational age. In the next step, analysis

of classification of the cases belonging to the two remaining groups of mothers (AGA and PTB) was carried out through two independent methods: discriminant function analysis and ROC analysis.

### Discriminant function analysis

Analysis of discriminant function for nine factors showed that three factors significantly affect the discriminative power. These were factors 1, 2 and 8 (Table 3) which in a statistically significant manner qualified mothers to Group AGA and Group PTB. Wilks' lambda of discriminant function constructed for the 9 factors studied was 0.711, with a statistical significance of  $P < 0.0014$ . The expected classification of mothers is presented in the classification matrix table, which compares the actual classification with the classification obtained from discriminant function analysis (Table 4). The rows show the actual classification: 43+11 mothers belonged to Group AGA and 14+18 mothers belonged to Group PTB. The classification based on discriminant function is displayed in the columns. It shows that 43+14 mothers belonged to Group AGA, and 11+18 mothers belonged to Group PTB. The function correctly classified 43+18 cases. Eleven cases were classified by discriminant function as Group PTB (preterm) when in fact they belonged to Group AGA. Similarly, 14 cases were classified by discriminant function as Group AGA, when actually they belonged to Group PTB. 79.63% of the cases were correctly classified as Group AGA, while 56.25% of the cases were correctly classified as Group PTB. Discriminant function correctly classified 70.93% of the total number of cases.

### ROC analysis

The final part of the data analysis involved the creation of the ROC curve (Receiver Operating Curve), the calculation of specificity (TNR), sensitivity (TPR), and determining the likelihood of positive, the likelihood of negative and accuracy (ACC). ROC analysis was only performed for factor 1, because the variables with the highest values of the factor load included in factor 1 were fatty acids. Factors 2 and 8 did not include fatty acids and therefore were not the subject of our study and were not analyzed further.

All the cases belonging to factor 1 (SSMCFA) in GAs A and PTB were sorted by the value of this factor (data not shown). The calculated cut-off value for factor 1 (SSMCFA) was 0.188. The value was determined for the maximum value of specificity and sensitivity. The expected classification of cases is presented in the classification matrix table, which compares the actual classification with the classification obtained based on ROC (Table 5). The rows show the actual classification (as it was in reality) - Group AGA consisted of 34+20 mothers. Group PTB consisted of 12+20 mothers. The columns show the classification based on ROC, according to which there were 34+12 mothers in Group AGA, while 20+20 mothers belonged to Group PTB.

ROC analysis qualified twenty cases as belonging to Group AGA whereas in fact they belonged to group PTB. 12 cases were classified as belonging to Group PTB when actually they belonged to group AGA (Table 5). For cut-off=0.188 the diagnostic method accepted the following values: sensitivity (TPR) 62.5%, specificity (TNR) 62.96%, positive predictive value (PPV) 50%, negative predictive value (NPV) 73.91%, accuracy (ACC) 62.79% (Figure 1). To study the relationship

**Table I.** Characteristic of the studied population. Results are mean ( $\pm$ SD).

	AGA	PTB	SGA
Age (y)	28.6 $\pm$ 4.7	27.7 $\pm$ 3.7	29.0 $\pm$ 5.1
BMI (kg/m <sup>2</sup> )	22.7 $\pm$ 3.8	23.2 $\pm$ 4.1	23.1 $\pm$ 4.8
Delivery (wk)	39.2 $\pm$ 1.2	34.65 $\pm$ 1.1	38.0 $\pm$ 1.0
Neonatal weight	3535.9 $\pm$ 392.9	2402 $\pm$ 424.5	2297 $\pm$ 158.9
Placental weight	499.2 $\pm$ 103.1	320.4 $\pm$ 98.6	358.6 $\pm$ 82.8
Mode of delivery	42n/12cs=54	21n/11cs=32	12n/11cs=23
Apgar score	9-10	9-10	9-10

**Table II.** Table showing the results of factor analysis – load value. Nine factors emerged from the analysis, containing at least one variable with a value of factor load (FL) above 0.7 (factor load > 0.7). The table shows only those variables where the absolute load value exceeds 0.7. The cumulative value of the variance of these factors was 90.93%.

Items	SSMCFA	WSV	LCPUFA	EFA	Energy	Vit A	Lactose	Alcohol	An prot
Energy (KJ)	0,440	0,320	0,089	<b>0,755</b>	-0,176	0,175	0,122	-0,123	0,141
Animal Protein	0,369	0,198	0,174	0,252	0,176	0,129	0,302	0,057	<b>0,736</b>
Fat	0,524	0,210	0,108	<b>0,774</b>	0,170	0,096	0,066	-0,067	0,121
Vitamine A	0,163	0,149	0,080	0,109	0,008	<b>0,935</b>	0,026	-0,013	0,028
Beta-carotin	0,078	0,159	0,079	0,009	0,002	<b>0,951</b>	0,008	-0,020	-0,004
Vitamine C	0,150	<b>0,893</b>	0,043	0,154	-0,007	0,168	0,036	-0,081	-0,097
C4:0	<b>0,971</b>	0,114	0,058	0,135	0,018	0,039	0,100	0,037	0,023
C6:0	<b>0,976</b>	0,113	0,040	0,126	0,012	0,044	0,081	0,045	0,024
C8:0	<b>0,963</b>	0,097	0,067	0,186	-0,001	0,071	0,098	0,037	0,032
C10:0	<b>0,964</b>	0,121	0,050	0,178	-0,012	0,073	0,079	0,040	0,038
C12:0	<b>0,945</b>	0,120	0,097	0,209	-0,007	0,079	0,098	0,024	0,029
C14:0	<b>0,946</b>	0,131	0,095	0,235	0,041	0,068	0,057	-0,007	0,094
C20:0	0,146	0,176	0,028	<b>0,887</b>	0,153	0,065	0,104	0,083	0,084
C18:1	0,381	0,195	0,075	<b>0,837</b>	0,198	0,078	0,037	-0,073	0,140
C22:1	0,276	-0,080	0,267	<b>0,759</b>	-0,037	0,031	-0,056	0,122	0,044
C18:2	0,056	0,302	0,141	<b>0,766</b>	0,243	0,072	0,191	0,222	0,018
C18:3	0,361	0,164	-0,074	<b>0,806</b>	0,061	0,058	0,038	0,159	-0,016
C18:4	0,004	-0,040	<b>0,948</b>	0,160	-0,015	0,035	0,016	-0,096	0,035
C20:5	0,105	0,002	<b>0,961</b>	0,120	0,005	0,040	0,038	0,010	0,069
C22:5	0,155	0,125	<b>0,939</b>	0,052	0,046	0,051	0,023	0,008	0,010
C 22:6	0,171	0,109	<b>0,947</b>	0,114	0,063	0,045	0,049	-0,007	0,075
Lactose	0,390	0,073	0,079	0,139	-0,027	0,108	<b>0,833</b>	-0,171	0,132
Alcohol	0,071	0,013	-0,066	0,136	0,218	0,015	-0,165	<b>0,724</b>	0,141
% energy fat	0,382	-0,141	0,073	0,365	<b>0,780</b>	-0,145	-0,050	0,092	0,028
% energy carbohydrates	-0,242	0,114	-0,074	-0,063	<b>-0,833</b>	0,130	-0,028	-0,221	-0,336

between true positives and false positives the ROC curve was plotted. The size of the area under the curve (AUC) was 0.630 (Figure 2).

Subsequently, the Odds Ratio (OR) or risk of premature birth was calculated in the group that was exposed to it, that is for which the value of SSMCFA factor was above the cut-off value. The value of OR was 2.83. This value means that the risk of exposure to prematurity with the diagnosis of Yes is 2.83 times greater than with the diagnosis of No. Analysis of the confidence interval for OR showed that it is between 1.05 and 7.76 ( $1.05 < OR < 7.76$ ). It can therefore be concluded with a 95% probability that OR is in such a range. This means that the risk of prematurity in the exposed group is greater than 1. Statistical significance determined on the basis of Chi-Squares statistics for OR was 0.022. Analysis of Relative Risk (RR), which is the proportion of prematurity in the unexposed group (prematurity in the group in which the value of the factor is above the cut-off value) to the probability of the exposed group (prematurity in the group below cut-off) was 1.92. The confidence interval for this value was between 1.08 and 3.41 ( $1.08 < RR < 3.41$ ). This means that the proportion of cases in Group PTB compared to cases in Group AGA in the exposed group is significantly higher than the proportion of cases in Group PTB to cases in Group AGA not exposed. In other words, the proportion of preterm babies to AGA in the group below the cut-off (exposed) is significantly greater than the proportion of preterm babies to AGA in the group above the cut-off (unexposed).

## Discussion

Planning our study, we wanted to determine the diet of women who give birth at the interface between physiology and pathology, and whose children show a small degree of deviation from accepted standards (SGA, prematurity of a small degree). We also wanted to determine whether you can predict these disorders based on the mother's diet, using statistical methods. To obtain this information we carried out analysis of the discriminant function, and – independently – ROC analysis. Both analyses were preceded by factor analysis (FA) of dietary components. Using FA, 9 factors were shown to contain at least one variable of value  $FL > 0.7$ . Analysis of variance showed differences only between Group AGA and Group PTB, therefore subsequent research did not include the dietary components of mothers whose children were SGA. Discriminant function analysis showed that only three factors significantly affected the discriminative power and accurately classified 70.93% of cases. The function classified 57 cases as Group AGA, when in fact there were 54 cases. 29 cases were classified as Group PTB, whereas in fact there were 32 cases. One of the factors on the basis of which we determined the discriminant function was SSMCFA containing short and medium-chain fatty acids. This factor alone underwent further analysis by the ROC method. The volume of the area under the ROC curve for factor 1 was 0.630 which meant that classification to the exposed and unexposed groups is not accidental. The test based on ROC showed that 46 cases out of 54 were classified as Group AGA, while 40 out of 32 cases were classified as Group PTB. Slightly larger differences in the classification of cases were observed in the ROC analysis. Similarly, 25 cases were identified as being incorrectly classified by discriminant function analysis (11+14), whereas 32 incorrectly classified cases were identified

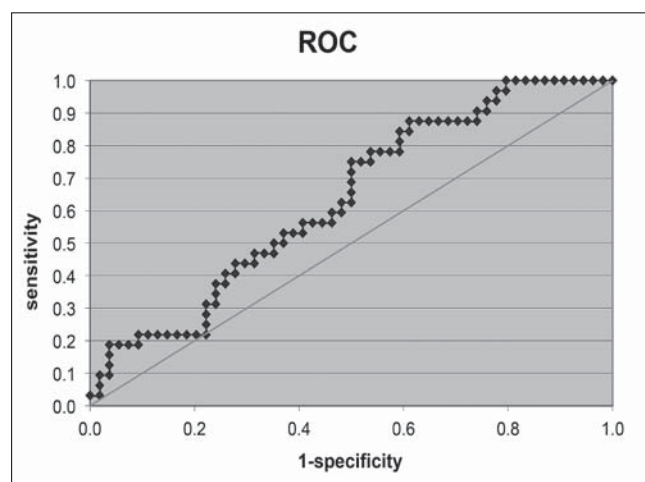


Figure 1. ROC curve for factor 1.

by ROC analysis (12+20). It can be understood that discriminant function was characterized by greater efficiency in classifying the cases, although the values of Wilks' lambda were relatively high, which meant that the contribution of 9 factors in the discriminant function was statistically significant. The ROC value was in turn determined only for one factor, representing short and medium-chain fatty acids. Therefore classification of the cases based on ROC could be seen to be slightly weaker, although it seemed more practical, because in classifying the cases by the ROC method far fewer variables were analyzed than by discriminant function analysis. Factors 2 and 8 were excluded from the ROC analysis due to the fact that they did not represent fatty acids we were interested in and, more importantly, they had a much smaller share in the variance than factor 1. Therefore, only one factor was analyzed to determine its diagnostic usefulness in predicting preterm birth or the birth of a healthy baby. Parameters such as TPR (sensitivity), TNR (specificity), PPV, NPV and ACC were calculated for SSMCFA. The value of TPR and TNR (that is, respectively, the usefulness of the method to a correct diagnosis and the usefulness of the method to the exclusion from a group suspected of having the disease) remained at the same level for both parameters and was approximately 63%. This meant that both parameters correctly diagnosed (TPR) or excluded (TNR) the disease (in the case of this article, prematurity) in 63% of cases. PPV value stood at 50%, which meant that there was random classification of mothers suspected of prematurity, with the factor value above the cut-off value.

In contrast, a good diagnostic value characterized NPV – 74%. This meant that 74% of mothers with factor value below the cut-off value were accurately diagnosed, that is, they gave birth to an AGA baby. The results showed that a higher factor 1 value may determine the birth of AGA children. This indicates, therefore, that a higher intake of short and medium-chain saturated fatty acids in the third trimester of pregnancy is conducive to giving birth to a healthy full-term baby.

Analysis of factor 1 in both analysis of variance and discriminant function analysis, indicated a significant proportion of short and medium-chain saturated fatty acids present in the diet of mothers in the maternal-placental-fetal metabolism.

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This result was crucial for our study as it confirmed the importance of these fatty acids in the process of formation and development of the child both during the fetal period and post-childbirth, which had already been shown in our previous studies. The composition and metabolism of SSMCFA is subject to change in mothers and their AGA children, "late" preterm children and SGA children. This applies to dietary components examined in this research and those analyzed in our previous studies of mother's blood [11], cord blood [11], transitional milk [12] and mature milk [12].

We have shown that the level of FAs, especially in their 10 and 12 carbon atom forms, is higher in cord blood and in mature milk in the following groups: "late" preterm and SGA. On the other hand, the increase in SSMCFA levels in pregnant women's diets is a factor influencing the birth of a healthy full-term baby. While interpretation of the above-mentioned results was not problematic at all, interpretation of the following results is more complex. Higher levels of the above-mentioned MCFAs in cord blood and breast milk were associated with a genetically programmed response of the mother's body to the needs of the fetus/baby. In the case of the preterm and SGA groups analyzed, this is probably due to energy requirements, for which the 10 and 12 carbon acids are ideal substrates due to the fact that in the mitochondrial energy production process they do not require the consumption of ATP during their transport into the mitochondria [11,12,14-16].

Therefore, there is no consumption of energy at the stage of its production, meaning more energy remains available for the child, which is particularly important for newborns and infants born prematurely or SGA. The influence of SSMCFAs consumed in the pregnant woman's diet on the maternal-fetal metabolism is certainly different. Analysis of the literature shows that their performance is mainly focused on the digestive system where they regulate the absorption of iron, calcium and magnesium [17]. They stimulate the growth and differentiation of intestinal epithelial cells, and inhibit the growth of many pathogens such as *Escherichia coli*, *Campylobacter* or *Salmonella* [18, 19].

This is just some of the information that can be found about the activity of short and medium-chain fatty acids. These activities are certainly important for the mother's health but it is difficult to determine whether they are at all beneficial for the baby, and if they are, then to what extent positive activity of SSMCFAs in the gastrointestinal tract of pregnant women affects the intrauterine development of the child. The possibility cannot be excluded that these acids act parenterally. It is known that depending on the length of the chain they are preferably hydrolyzed in the intestines and then absorbed without chylomicrons [16, 20].

After passing through the placenta using specific transport systems for fatty acids, they may be used in the proteins acylation process of the fetus, for example, the acylation of histone proteins which are often acylated by SSMCFA residues. The acylation of histones pattern in the given chromatin area is pivotal for the processes of transcription of genes located in this place. It cannot, therefore, be excluded that because of the diet of pregnant women, changes in the content of SSMCFA in fetal blood cause slight changes in fetal development, which result in premature labor [21].

**Table III.** Research on discriminant function for nine factors showed that three factors significantly affected the discriminative power. These were factors 1 - SSMCFA, 2 - WSV and 8 - ALCOHOL, in a statistically significant manner qualifying mothers to Group AGA and Group PTB. Wilks' lambda for the discriminant function constructed for 9 studied factors was 0.711, with a statistical significance of  $P < 0.0014$ .

Factor	Wilks' lambda	Wilks' Particle	P
SSMCFA	0,749	0,950	<b>0,04817</b>
WSV	0,766	0,929	<b>0,01858</b>
LCPUFA	0,722	0,986	0,29549
EFA	0,714	0,996	0,57712
ENERGY	0,719	0,990	0,37631
VIT A	0,718	0,991	0,39787
LACTOSE	0,714	0,996	0,59122
ALCOHOL	0,887	0,803	<b>0,00005</b>
AN PROT	0,713	0,998	0,66397

**Table IV.** The rows show the actual classification in which there were 43+11 mothers in Group AGA and 14+18 mothers in Group PTB. The columns show the classification based on the discriminant function. 43+14 mothers belonged to Group AGA, whereas 11+18 mothers belonged to Group PTB. 43+18 cases were correctly classified by the function. Eleven cases classified to Group PTB by the discriminant function in fact belonged to group AGA. And finally 14 cases were classified by the discriminant function to Group AGA, but actually belonged to Group PTB.

	% corrected	Group AGA	Group PTB
<b>Group AGA</b>	79,63	<b>43</b>	11
<b>Group PTB</b>	56,25	14	<b>18</b>
<b>Σ</b>	<b>70,93</b>	57	29

**Table V.** The predicted classification of the cases comparing the actual classification with the classification based on ROC. The rows show the actual classification, whereas the classification based on ROC, that is the diagnosis, is shown in the columns. According to ROC, 46 cases were not classified as premature births, therefore they were classified as Group AGA (column No). 40 cases were classified as premature births (column Yes). Twenty cases were classified by ROC analysis as belonging to Group AGA but in fact they belonged to Group PTB. And finally, 12 cases were classified as Group PTB, but actually belonged to group AGA.

Group	No	Yes	Σ
<b>Group AGA</b>	34	20	54
<b>% column</b>	73,91%	50,00%	
<b>% row</b>	62,96%	37,04%	
<b>Group PTB</b>	12	20	32
<b>% column</b>	26,09%	50,00%	
<b>% row</b>	79,31%	20,69%	
<b>Σ</b>	46	40	86

**Oświadczenie autorów:**

1. Rafał Bobiński – autor koncepcji i założeń pracy, przygotowanie manuskryptu i piśmiennictwa – autor zgłaszający i odpowiedzialny za manuskrypt.
2. Monika Mikulska – zebranie materiału, analiza statystyczna wyników, przygotowanie manuskryptu.
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4. Izabela Ulman-Włodarczyk – autor założeń pracy, analizy i interpretacji wyników, przygotowanie, korekta i akceptacja ostatecznego kształtu manuskryptu
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**III ULTRASONOGRAFIA  
W GINEKOLOGII I POŁOŻNICTWIE**

**Sekcji USG PTG**

V Podhalańska Praktyczna Ultrasonografia  
w Ginekologii i Położnictwie  
Kurs Ultrasonograficzny

**28 maj 2015**  
Warsztaty praktyczne - Podhalański Szpital Specjalistyczny w Nowym Targu

**29 - 30 maj 2015**  
Wykłady - Centrum Kongresowe Belvedere w Zakopanem

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Przewodniczący Komitetu Naukowego i Organizacyjnego

**Jacek Brązert**  
Honorowy Przewodniczący

**Mariusz Dubiel**  
Perinatal Doppler Focus Group

**Hubert Wolski**  
Podhalański Szpital Specjalistyczny  
w Nowym Targu

Sekcja Ultrasonografii Polskiego Towarzystwa Ginekologicznego  
Sponsorowana przez Radę Złoty Wątek i Drodzka  
Akademia Pedagogiki i Edukacji Kobiecych Uniwersytetu Medycznego im. K. Marcinkowskiego w Poznaniu  
Główny Patronat: Ginekologię Podhalańską Szpitala Specjalistycznego im. J. Jura-Pawła 11

Informacje: [www.usgptg.pl](http://www.usgptg.pl) tel. +48 61 84 19 334  
Termin zgłaszania prac do 30 marca 2015

**PROGRAM RAMOWY****Piątek, 29.05.2015**

I sesja: Obrazowanie wczesnej ciąży – 5-10 tydzień

II sesja: Nowe schematy diagnostyki prenatalnej między 11-14 tygodniem ciąży

III sesja: Ocena blizny po cięciu cesarskim. Diagnostyka ultrasonograficzna łożyska wrosniętego, przerosniętego i przodującego

IV sesja: Rola ultrasonografii w okresie okołoporodowym

Pokazy filmowe trisomii 21, 13, 18

**Sobota, 30.05.2015**

V sesja: Ocena ultrasonograficzna macicy i jajników oraz badania hormonalne w diagnostyce niepłodności

VI Sesja: Diagnostyka prenatalna wad rozwojowych cz.I

VII sesja: Terapia płodu. Ciąża wielopłodowa

VIII sesja: Wybrane zagadnienia z diagnostyki ultrasonograficznej w ginekologii

Panele tematyczne do zgłaszania prac do 30.03.2015:

- I – wczesna ciąża 5-10 tygodni
- II – diagnostyka prenatalna 11-14 tygodni
- III – ocena blizny po cięciu cesarskim, patologia łożyska
- IV – ultrasonografia w okresie okołoporodowym
- V – niepłodność
- VI – wady rozwojowe
- VII – rak jajnika, rak gruczołu piersiowego, ultrasonografia w uroginekologii

Możliwości prezentacji i przysyłania prac:

- streszczenie i model plakatu elektronicznego
- praca do publikacji w ginekologii polskiej według zasad GP
- Wyróżnione streszczenia i prace prezentowane w poszczególnych sesjach tematycznych
- Plakaty elektroniczne będą prezentowane na ekranach telewizyjnych przez cały okres kongresu
- Publikacja streszczeń w materiałach kongresu

**Zapraszamy**  
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