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# Association of food choices during pregnancy with gestational diabetes mellitus

## ABSTRACT

**Introduction.** Prevalence of gestational diabetes mellitus (GDM) is continuously increasing worldwide. Nutritional factors are considered to play important role in GDM development. The aim of this pilot study was to assess a relationship between frequency of consuming particular foods and GDM. Also pre-pregnancy BMI, weight gain during gestation, maternal age, pregnancy week at the time of delivery, newborn birthweight, family history of diabetes, educational status and place of residence were included into analysis.

**Material and methods.** Study group consisted of 25 women who developed GDM, while control group consisted of 25 age-matched women with normal glucose tolerance (NGT) during gestation. All study participants completed the food frequency questionnaire with additional socio-demographic, anthropometric and pregnancy course data.

**Results.** Women with GDM significantly more frequent consumed white bread, white rice, sausages/frankfurters and fast-foods, while they significantly less frequent consumed wholegrain bread, milk, sour dairy products, fruit and vegetables. They had also higher pre-pregnancy BMI, greater weight gain during pregnancy, and their newborns had higher birthweight.

**Conclusions.** Results of our study indicate a crucial role of food choices during pregnancy in GDM develop-

ment. It also indicate the need for professional dietary advice from the very beginning of gestation or even before conception, and during the entire pregnancy. (Clin Diabetol 2017; 6, 4: 131–135)

**Key words:** gestational diabetes mellitus, body mass index, food, dietary habits, pregnancy

## Introduction

The prevalence of GDM differs worldwide. In Europe it affects 5.8% of pregnancies in average, with notable regional variations. In Western Pacific region higher prevalence of GDM is observed with the median 11.7%. It should be remembered that in different studies various diagnostic criteria were used and this explains notable differences in the obtained results [1]. Studies in which International Association of Diabetes in Pregnancy Study Groups (IADPSG) diagnostic criteria were used, demonstrated notably higher GDM prevalence, exceeding 10% of all pregnancies in European countries [1–3]. In Poland, before introduction of new World Health Organization (WHO) diagnostic criteria [4] it was counted to affect 2–4% of all pregnancies [5].

GDM is associated with unfavorable outcome both for the mother and for the offspring [2–4, 6, 7]. Short-term adverse outcomes include preeclampsia and primary cesarean delivery for the mothers, and higher birth weight, higher cord C-peptide and higher body fat for the babies [2–4, 6]. Long-term negative health effects include future development of type 2 diabetes, which occurs in roughly 50% of women with the history of GDM, and significantly higher risk of obesity, metabolic syndrome and type 2 diabetes in their offspring [2, 6, 7].

Several modifiable (e.g. low physical activity, unhealthy dietary habits, endocrine disruptors' exposure),

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**Table 1. Characteristics of the GDM and NGT groups. Results are presented as mean  $\pm$  standard deviation (SD) or numbers. Significant differences in bold**

Parameter	GDM	NGT	P value
Maternal age at delivery (years)	28.8 $\pm$ 4.6	27.4 $\pm$ 4.2	0.266
Occupation			0.089
Rural/small town < 50,000 inhabitants	15	8	
City > 50,000 inhabitants	10	17	
Level of education			1.000
Secondary	7	6	
Higher	18	19	
Pre-pregnancy BMI [kg/m <sup>2</sup> ]	<b>24.47 <math>\pm</math> 3.52</b>	<b>20.70 <math>\pm</math> 2.54</b>	<b>&lt; 0.001</b>
Weight gain during pregnancy [kg]	<b>13.12 <math>\pm</math> 3.21</b>	<b>10.24 <math>\pm</math> 3.36</b>	<b>0.003</b>
Newborn birth weight [g]	<b>3474 <math>\pm</math> 254</b>	<b>3207 <math>\pm</math> 257</b>	<b>&lt; 0.001</b>
Gestational age at delivery (weeks)	39.6 $\pm$ 1.2	39.4 $\pm$ 1.7	0.992
Family history of diabetes	12	10	0.776
Source of information on diet in pregnancy			<b>0.048</b>
<b>Books</b>	<b>7</b>	<b>18</b>	<b>0.005</b>
Press/brochures/guides	10	15	0.258
Internet	16	14	0.773
<b>Training/workshop/birth school</b>	<b>4</b>	<b>13</b>	<b>0.017</b>
Family/friends	11	6	0.232

as well as non-modifiable factors (e.g. maternal age, genetic factors) are associated with elevated GDM risk [8, 9]. Among dietary factors associated with higher risk of GDM development, Western dietary patterns and diets rich in animal fat and animal protein are listed [8]. On the other hand Mediterranean and Dietary Approach to Stop Hypertension (DASH) diets, as well as diets high in fiber and nuts seem to be protective [8–10]. However, interventional studies assessing the effect of dietary and lifestyle intervention on GDM development gave inconsistent and controversial results [8, 9].

The aim of our pilot, retrospective study was to assess impact of dietary habits and food choices made by pregnant women on GDM development in a real-life setting.

## Methods

The study group consisted of 25 women who developed GDM during pregnancy and 25 age-matched women with NGT throughout the gestation. According to current clinical practice recommendations from Diabetes Poland and Polish Gynecological Society fasting plasma glucose measurement should be performed in all pregnant women at the beginning of pregnancy, at the first visit to the obstetrician, and obligatory oral glucose tolerance test (OGTT) should be performed between 24 and 28 week of gestation [11, 12]. In all cases GDM was diagnosed using current WHO criteria [5]. All study subjects were of Caucasian ethnicity and all patients gave birth in the same Department of Gyne-

cology and Obstetrics in one of the specialist hospitals in Rzeszów, Podkarpackie Province, Poland.

Study participants completed a food frequency questionnaire assessing consumption of different nutrients during pregnancy (every day; 4–5 times a week; 2–3 times a week; once a week; 1–3 times a month; never). Food products were divided into groups: starch products (white bread; whole meal bread; white rice; groats; pasta and potatoes), meat and fish (poultry; red meat; fish; smoked meat/sausages/frankfurters), dairy products (milk; sour dairy products; yoghurts; cottage cheese; hard cheese, e.g. Cheddar), fruits and vegetables, fruit juices and Western diet patterns (sweets, sugar sweetened beverages, fast-foods, chips, cakes). Also socio-demographic and anthropometric data: maternal age at delivery, occupation, level of education, pre-pregnancy body height and weight with calculated BMI, weight gain during pregnancy, birth weight of newborn and gestational age at delivery were collected. In addition data regarding family history of diabetes and history of comorbidities were collected. Finally, patients were asked about their sources of information on healthy diet during gestation. Characteristics of the study population are presented in the Table 1.

Statistical analysis of the data was performed using SigmaPlot for Windows, version 12.5 (Systat Software Inc., San Jose, CA, USA). The numerical data are presented as numbers. The continuous data are presented as mean  $\pm$  SD (standard deviation). Differences

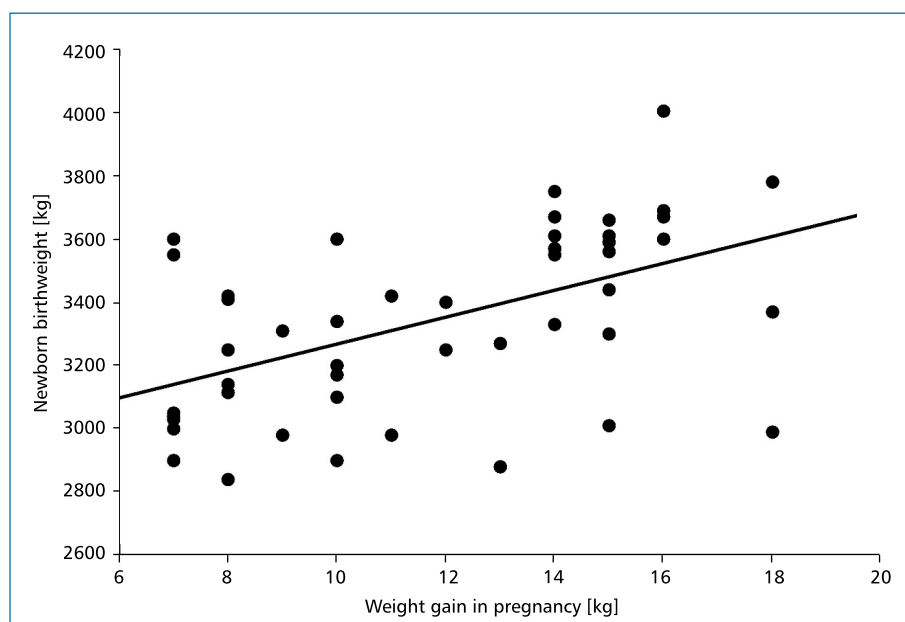


Figure 1. Linear correlation between weight gain during pregnancy and newborn birthweight

between patients with GDM and NGT were analyzed using an unpaired two-tailed Student's t-test or by a Mann-Whitney rank sum test where appropriate. The categorical data were compared using  $\chi^2$  test. OR (odds ratios) were not calculated due to relatively small study group. The associations between GDM and analyzed variables were assessed using Pearson Product or Spearman rank order correlation test where appropriate. A P value of  $< 0.05$  was considered statistically significant.

The study was approved by Bioethics Committee at the University of Rzeszów and by the all appropriate administrative bodies, and it was conducted in accordance with the ethical standards laid down in an appropriate version of the 1964 Declaration of Helsinki (as revised in Brazil, 2013). All study participants signed informed consent form before completing the questionnaires.

## Results

Women who developed GDM had significantly higher pre-pregnancy BMI and their weight gain during pregnancy was significantly greater compared to the control group. Also mean birthweight of offspring from mothers with GDM was significantly higher (Tab. 1). However, in none of the newborns in GDM group, the birthweight exceeded 4 kg. We found also a strong linear relationship between weight gain during pregnancy and a birthweight of newborns,  $r = 0.529$ ,  $p < 0.001$ , irrespective of glucose metabolism status (Fig. 1). We did not find significant differences in maternal and gestational age at delivery between the two groups. Also no differences in the family history of diabetes, and level of education were observed. A trend towards more frequent rural and small town place of residence

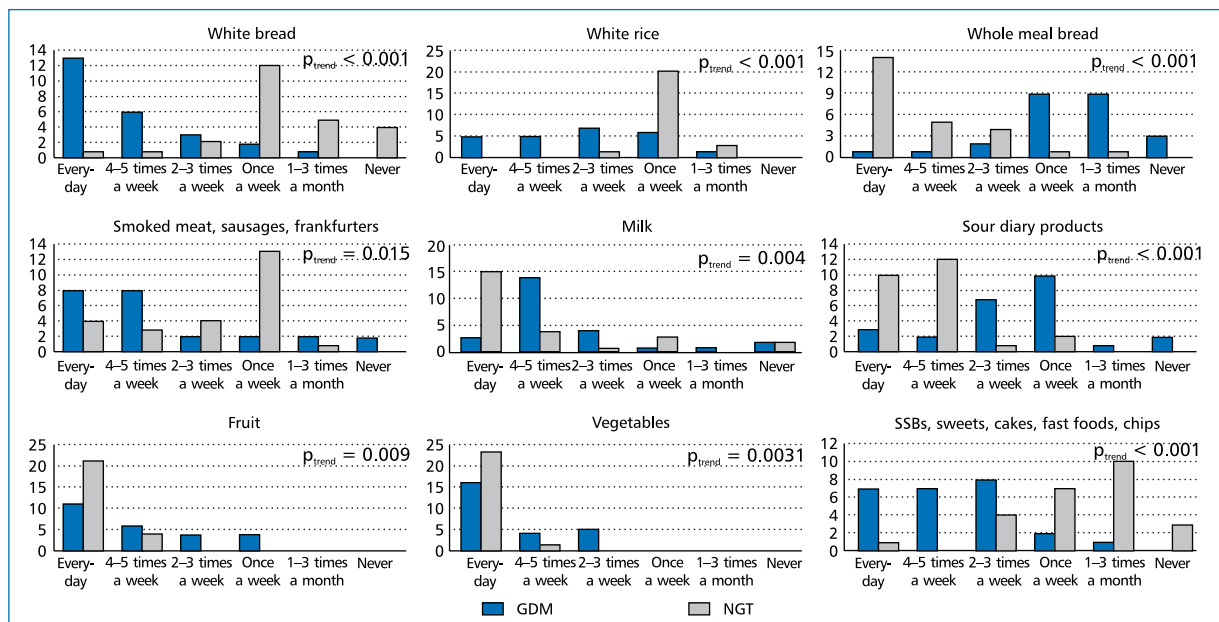
in GDM group was noted, but this difference did not attain statistical significance (Tab. 1).

In comparison with GDM group, women with NGT significantly more frequent were using books as a source of information on healthy diet in pregnancy. They also more frequent participated in trainings and workshops or attended birth schools compared to women with GDM and thence drew their knowledge of healthful diet and physical activity during gestation (Tab. 1).

Dietary habits during pregnancy appeared to be significantly different between patients with GDM and women with NGT (Fig. 2). Differences were observed in each group of nutrients. Compared to NGT group patients with GDM significantly more frequently consumed white bread, white rice, smoked meats/sausages/frankfurters and products from western dietary patterns, while they consumed significantly less frequent whole meal bread, milk, sour dairy products, fruits and vegetables. In further analysis also poultry consumption and drinking of fruit juices more frequently than once a week were significantly more prevalent in women with GDM compared to NGT group (21 vs. 11 persons,  $p = 0.008$  and 25 vs. 19 persons,  $p = 0.022$  respectively), while yoghurts consumption at least 4 times a week was significantly less prevalent in GDM group (13 vs. 22 persons,  $p = 0.014$ ).

## Discussion

Results of our pilot study indicate important role of diet in development of GDM. Refined starch products, sausages, frankfurters and smoked meats, and more frequent use of products from western dietary patterns



**Figure 2.** Significant differences in food choices between women with GDM and NGT

were significantly associated with GDM risk, while more frequent consumption of whole meal bread, milk and sour dairy products, fruits and vegetables was related to lower GDM risk.

Various dietary interventions to prevent or to treat GDM were studied in the past. Recently published systematic review of observational studies indicate elevated GDM risk among women consuming higher amounts of red and processed meat, eggs ( $\geq 7$  a week), cholesterol ( $\geq 300$  mg/day) and replacing 1–5% energy from carbohydrates with fat. Diet rich in fruit, vegetables, whole grains and fish, and low in red and processed meat, refined grains, and high-fat dairy appeared to decrease GDM risk [13]. Our results confirmed most of these findings. However, in contrast to data from the review, in our study also dairy appeared to be beneficial. Frequency of consumption of red meats and fish in our observation was low in both groups, and no differences between them were found.

In two studies by Zhang et al. based on data from Nurses' Health Study II (NHS II) Western dietary pattern and high glycemic load appeared to be positively related to GDM risk, while "prudent" diet characterized by a high intake of fruit, green leafy vegetables, poultry and fish, and high fiber diet showed protective effect against GDM [14, 15]. Our study confirmed these findings. However, interestingly, in our observation poultry consumption more frequent than once a week was associated with elevated risk of GDM.

In a recent study higher consumption of sugar sweetened soft drinks before pregnancy was associated with elevated GDM risk [16]. Another study revealed

that excessive fruit consumption was also related to GDM risk [17]. In our study sugar sweetened beverages as a part of Western dietary pattern were also associated with GDM risk, while fruit consumption was found to be beneficial.

Our study is not free from several important limitations. First of them is small study group. Another one is its retrospective and observational design and lack of data regarding GDM treatment in majority of cases. On the other hand, it reflects the real-life situation and presents actual dietary habits of Polish pregnant women. Obviously, much larger studies are required to confirm our findings. Nevertheless, it seems that excessive consumption of refined starch, smoked meats/sausages/frankfurters and products from Western dietary pattern are the most responsible factors for elevated GDM risk, while whole grain products, fruit and vegetables, milk and sour dairy products seem to play protective role. Also poultry and fruit juices should be consumed with caution. Pregnant women should use reliable sources of information regarding healthy diet and physical activity during pregnancy to avoid excessive weight gain during gestation. It is also of utmost importance for women planning pregnancy to take care of their body weight before becoming pregnant.

In summary, our results indicate the strong need for professional dietary and lifestyle advice from the beginning of gestation or even at the time of planning conception, and during the entire pregnancy.

## Acknowledgement

The study has not been granted.

## Conflict of interest

The authors report no conflicts of interest.

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