RESEARCH LETTER

Dietary habits of pregnant women with type 1 diabetes: do they differ from healthy controls?

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Introduction Proper nutrition during pregnancy in women with type 1 diabetes mellitus (T1DM) is essential for both the mother and the fetus. The appropriate dietary management and well-balanced insulin therapy are crucial for the optimization of glycemic control and have a positive impact on maternal-fetal outcomes.[1] It is known that an unbalanced diet and irregular meals may lead to nutritional deficiencies, excessive weight gain, and inadequate metabolic control of diabetes, which can negatively affect fetal development.[2,3] To the best of our knowledge, eating behavior of pregnant women with T1DM has not been studied yet. Therefore, this study aimed to analyze the dietary patterns of that population.

Patients and methods A study of 52 pregnant women with T1DM (group A) and 39 healthy controls (group B) was conducted in the Division of Reproduction in Gynecologic and Obstetrical University Hospital in Poznań, Poland. Inclusion criteria for both groups were age 18 to 45 years and single, term pregnancy (37+0–41+0). Patients with T1DM received multidisciplinary care, including regular dietary education delivered by diabetes educators. The control group consisted of unselected healthy pregnant women admitted to the clinic at term pregnancy, and we did not provide them with any nutritional advice neither in the early pregnancy nor at term hospitalization. The time of recruitment was the same in both groups. Our study was part of a larger project on maternal and fetal microbiome. Patient characteristics are presented in Supplementary material online (Supplementary material, *Table S1*).

A nutritional assessment was carried out face-to-face, using 24-hour dietary recalls for 7 consecutive days (day-by-day) during the last hospitalization before delivery.[4] To estimate the amount of food consumed, participants used household measurements or grams and verified them using the Photo Album of Products and Dishes published by the Polish Institute of Food and Nutrition.[5] To analyze the daily food intake, a database in the Microsoft Access 2011 software (Microsoft Corporation, Redmond, Washington DC, United States) was created. The Dietetyk 2011 computer software (JuMaR, Poznań, Poland) based on a Polish database comprising tables of the nutritional value of food was used to perform a qualitative and quantitative analysis of daily food intake.[6] The results were compared to nutritional standards for pregnant women with low physical activity.[7,8] For ingredients for which standards have been developed on Estimated Average Requirement (EAR) levels (except iron), we performed a cutoff point method and we presented the obtained data as the percentage of patients who consumed lower than the norm.

Moreover, information about the participants and their dietary habits was collected based on the authors' survey and the assessment of the validated Food Frequency Questionnaire (FFQ-D10).[9] Women were asked to indicate the frequency of consumption of foodstuffs within the last 12 months with a special focus on the period of their pregnancy. The results were converted to a daily frequency indicating how many portions of a selected product were consumed within one day. Participants could choose one of the following answers: never (conversion factor: 0 portion/day), once a month or less often (0.025 portion/day), 2 to 3 times/month (0.083 portion/day), 1 to 2 times/week (0.214 portion/day), 3 to 4 times/week (0.5 portion/day), 5 to 6 times/week (0.786 portion/day), once a day (1 portion/day), 2 to 3 times/day (2.5 portions/day), 4 to 5 times/day (4.5 portions/day),

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at least 6 times/day (6 portions/day). Evaluation of the frequency of consumption included the following food groups: dairy products and eggs, sweets and snacks, cereal products, fats, fruit, vegetables and grains, meat products and fish, beverages, probiotic and prebiotic products. During the collection of data, we asked participants also about the supplementation of iron, probiotics, and symbiotics in the form of tablets, capsules, or powder.

Statistical analysis Statistical analysis was carried out using the STATISTICA 13.1 software packages (StatSoft, Kraków, Poland). The Shapiro–Wilk test was used to check for normality of data distribution. The results were presented as median with interquartile ranges. The statistical significance of the results between the groups (A vs B) was determined with the use of the Mann–Whitney test. The significance level was set at a *P* value of less than 0.05.

The Institutional Ethical Committee approved the study protocol of the Poznan University of Medical Sciences (no.132/13;241/13;194/14). Written informed consent, in accordance with the Declaration of Helsinki, was obtained from each patient.

Results The analysis of the 24-hours dietetic recall for 7-days showed that the energy intake was similar in both groups (TABLE 1). The protein and fat intake were higher in group A. Diabetic women consumed less carbohydrates and a higher amount of fiber compared to the control group. In both groups, the intake of these basic nutrients was lower than recommended.

All women consumed too much sucrose and energy from saturated fatty acids. The differences were not statistically significant. The analysis also revealed that the percentage of total energy from protein and fat was higher in group A, but the rate of total energy from carbohydrates was higher in group B.

The amount of all analyzed vitamins and minerals was higher in group A; however, in both groups, the consumption of vitamin D, folic acid, calcium, and iron was lower than recommended. Moreover, the intake of vitamin B_1, potassium, and magnesium in the control group were insufficient. The consumption of other analyzed vitamins and minerals, regardless of the group, exceeded the existing nutritional recommendations. Apart from sodium and calcium, differences in the level of intake of vitamins and minerals between groups were observed.

The analysis of nutritional behavior concerning the consumption of probiotic and symbiotic supplements showed that all women have not been consuming any of them over the last year. However, due to pregnancy, all women supplemented iron.

The results from the FFQ-D10 are presented in Supplementary material online (Supplementary material, *Table S2*). Our results showed that the food groups which were consumed the most frequently by all women were: vegetables and grains, fruit, fats. Group A consumed smaller amounts of sweets and salty snacks, as well as dairy products and eggs than group B. In both groups, we observed low consumption of probiotic products and high of prebiotic products. Diabetic women consumed a higher amount of probiotic yogurts and fewer bananas than the control group. Except for probiotic yogurts and bananas, there were no statistically significant differences in the frequency of consumption of selected food groups between the groups.

Discussion Poor nutrition and excessive body weight gain in pregnant, diabetic women are associated with obstetric complications, so they should limit high glycemic index carbohydrates and fat products and increase the consumption of low-carbohydrate products with a small amount of fat.[1-3,7]

Taking into consideration women's diet during hospitalization, it should be noted that although 24-hour dietary recalls were based on a hospital diet, we observed a significant percentage of patients who consumed considerable amount of foodstuff from outside. We noticed that most women did not consume hospital dinner but their own. Participants enriched the hospital meals in vegetables or dairy, whereas women in the control group in sweets (chocolate candy and chocolate bars) and fruit (bananas, apples).

The daily food rations deviated from the recommendations and were unbalanced regarding the content of basic nutrients, vitamins, minerals, and energy value in both groups, which is in line with the results of other authors.[1,2] Similarly to our findings, Villar-Vidal et al[10] observed among 2585 Spanish pregnant women that most of them did not meet the recommendations regarding the consumption of cereals, fruit, vegetables, and dairy products. On the other hand, Arkkola et al[11] observed that food choices among Finnish pregnant women were somewhat healthy and correct. It shows different dietary trends across Europe.

Summarizing our results concerning the frequency of consumption of the selected foodstuffs, no statistically significant differences were found between the women with T1DM and controls. Similar results were observed in a study by Petersen et al,[12] in which patients with and without diabetes had a comparable intake of all the major food groups. Sadowska et al[2] showed similar findings among women with GDM and healthy controls. Obtained results are in accordance with the Standards of Polish Society of Gynecologists and Obstetricians in the management of women with diabetes.[7] The other study showed that a diet with a low glycemic index has a positive effect on glycemic values and pregnancy outcomes not only in women with diabetes but also for healthy ones.[1]

The present results indicated that the nutritional behavior of pregnant women with T1DM and without diabetes was similar. However, it

TABLE 1 Basic nutrients in daily food rations of the study and control groups

Nutrient	Group A[a]	Group B[b]	Standard		% below cutoff point		*P* value
			Group A	Group B	Group A	Group B	
Energy, kcal	1803 (1586–2099)	1800 (1630–2034)	2340	2579	97	100	0.70
Protein, g	82.0 (66.2–97.7)	71.5 (64.6–87.7)	117	92.4	100	100	0.09
Protein, %	18 (14.4–21)	16.6 (14.2–18.6)	20	14	83	0	0.10
Fats, g	67.5 (54.1–80.9)	57.1 (58.7–62.5)	78	102	69	100	0.03
Fats, %	32.2 (26.9–38.2)	29.3 (23.6–33)	30		21	69	0.01
SFA, %	13.9 (11–15.7)	11.5 (9.32–14.5)	<10		10	23	0.03
MUFA, %	12 (9.74–14.6)	10.3 (8.36–13.2)	–[c]			–	0.03
PUFA, %	3.88 (3.23–4.56)	3.53 (3–5.16)	–[c]			–	0.79
Cholesterol, mg	228 (195–356)	198 (156–302)	≤300			–	0.02
Carbohydrates, g	249 (213–308)	270 (233–294)	293	361	83	100	0.39
Carbohydrates, %	48.7 (43.2–55.7)	54.1 (48.9–61)	50	56	69	62	0.003
Fiber, g	25.4 (20.5–30.1)	16.4 (14.8–21.5)	According to the physician's recommendation			–	<0.001
Sucrose, %	11.2 (8.11–15.9)	10.5 (7–14.3)	≤10		34	31	0.25
Vitamin A, µg	1022 (732–1464)	790 (453–1033)	530[d]		7	23	0.002
Vitamin E, mg	8.25 (6.09–11.6)	6.89 (4.87–8.83)	10[e]			–	0.001
Vitamin C, mg	110 (70.6–168)	55.9 (41.7–84.8)	70[d]		21	62	<0.001
Vitamin B_1, mg	1.36 (1.04–1.82)	1.08 (0.91–1.28)	1.2[d]		24	54	<0.001
Vitamin B_2, mg	1.76 (1.40–2.45)	1.39 (1.17–1.73)	1.2[d]		10	0	<0.001
Vitamin B_6, mg	2.1 (1.67–2.7)	1.65 (1.25–1.88)	1.6[d]		24	31	<0.001
Vitamin B_{12}, µg	3.24 (2.65–4.21)	2.53 (2.02–3.42)	2.2[d]		10	31	0.001
Vitamin D, µg	1.64 (1.29–2.37)	1.47 (1.05–1.81)	15[e]			–	0.01
Niacin, mg	15.8 (12.6–23.3)	14.2 (11.3–17.9)	14[d]		28	38	0.02
Folic acid, µg	321 (245–394)	249 (197–300)	520[d]		93	100	<0.001
Sodium, mg	2063 (1540–2504)	1868 (1463–2241)	1500[e]			–	0.08
Potassium, mg	3431 (2945–3940)	2412 (2023–3158)	3500[e]			–	<0.001
Magnesium, mg	305 (258–364)	229 (188–297)	300[d]		41	85	<0.001
Calcium, mg	669 (444–993)	590 (435–798)	800[d]		72	85	0.14
Phosphorus, mg	1334 (1076–1563)	1111 (1001–1346)	580[d]		0	0	<0.001
Zinc, mg	11.5 (9.93–13.6)	9.38 (7.52–11.0)	9.5[d]		24	46	<0.001
Iron, mg	9.47 (8.23–11.6)	9.55 (8.33–11.8)	23[d]			–	<0.001
Copper, mg	1.20 (1.01–1.42)	0.97 (0.78–1.1)	0.8[d]		10	8	<0.001

Data are presented as median (interquartile range). Data were analyzed using the Mann–Whitney test.

a Pregnant women with type 1 diabetes mellitus

b Pregnant women without type 1 diabetes mellitus

c No reference value has been established (dietary reference values)

d Estimated average requirement

e Adequate intake

Abbrevations: MUFA, monounsaturated fatty acids; PUFA, polyunsaturated fatty acids; SFA, saturated fatty acids

should be emphasized that despite no statistically significant differences, the dietary pattern of women with T1DM was more prohealth. It was related to the higher consumption of whole grain products and probiotic products, and lower consumption of fruit and sweets with a high glycemic index compared with other product groups.

The most significant limitation of our study was the small number of participants. Nevertheless, it involved a standardized evaluation of diet and dietary habits using several research tools. Moreover, to the best of our best knowledge, similar data from the Polish population have not been published yet.

Our study showed that there is the urgent need for dietary education of women of reproductive age. Better nutritional awareness before, during, and after pregnancy would translate into better health of the mother and her offspring.

SUPPLEMENTARY MATERIAL

Supplementary material is available at www.mp.pl/paim.

ARTICLE INFORMATION

NOTE PG is a member of Club 35, a Polish Society of Gynecologists and Obstetricians.

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CONFLICT OF INTEREST None declared.

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