The assessment of pregnant women's risk awareness and dangers resulting from gestational diabetes: A preliminary report

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Abstract

Background. During pregnancy, 2 main types of carbohydrate tolerance disorders may occur: pregestational diabetes mellitus and gestational diabetes mellitus (GDM). Gestational diabetes mellitus constitutes 90% of the cases diagnosed during pregnancy; 10% of the cases are previously undetected type 1 diabetes. In the subsequent pregnancy, in as many as 30% of the women, GDM will occur again.

Objectives. To determine the level of awareness of the women diagnosed with GDM concerning the diagnosis and self-control of diabetes, as well as the risk of poorly controlled or treated gestational diabetes. In particular, the attention was paid to the women's awareness of self-control and dietary behavior, depending on their age, education, number of pregnancies, and quality of medical care.

Materials and methods. One hundred women with gestational diabetes were accepted as the study group. To achieve the research goal, the study used a questionnaire consisting of 46 questions.

Results. As a result of the analysis, a relatively high level of awareness was found among 31.3% of the women aged 19–24, which decreased with age. It was noticed that the level of women's awareness of metabolic complications in pregnancy did not increase along with the potential experience and practically acquired knowledge related to earlier pregnancy. However, with age, the awareness of the need to change the lifestyle with focus on physical activity increased, although it did not matter whether it was the first or the subsequent pregnancy.

Conclusions. The results emerging from this study provide a perfect basis for conducting further research in a given direction, as they highlight many dependencies that can potentially influence the awareness of various aspects related to gestational diabetes.

Key words: pregnancy, diabetes, women, awareness, gestational

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Background

Gestational diabetes mellitus (GDM) constitutes 90% of the cases of hyperglycemia diagnosed during pregnancy. Insulin resistance is considered to be the leading cause of GDM. In most healthy women, blood insulin levels are approx. 50% higher at the end of pregnancy, which covers the increased demand resulting from developing insulin resistance. About 5% of pregnant women have a relative insulin deficiency, which is the cause of the development of GDM, due to the greater demand of the body for insulin.[1–7] Many additional risk factors increase insulin resistance and insulin deficiency: becoming pregnant after 35 years of age, giving birth to a child with the body weight >4000 g, having a child with a developmental defect, intrauterine fetal death, hypertension, obesity or overweight, having a family history of type 2 diabetes, GDM in previous pregnancies, giving birth to many children, or polycystic ovary syndrome.[2,3,8] The American Diabetes Association (ADA) annually publishes recommendations for good quality of medical care in diabetes.[9] High level of medical care characterized in this study should provide the women with the basic knowledge of self-control, dietary or pharmacological treatment, and lifestyle changes.

Current Polish epidemiological data indicate the frequency of GDM at the level of 3–12% in the population of pregnant women (21.64% – in women over 35 years of age). In the USA, the level of about 9% is noted.[10,11] The epidemiological data from the registers of DeSisto et al.[12] and the estimates of the prevalence of GDM in the Pregnancy Risk Assessment Monitoring System (PRAMS) show the frequency of GDM at the level of 1–25% in the population of pregnant women. The percentage discrepancy depends on the pregnant women's ethnicity and the diagnostic criteria used in a given region.

Uncontrolled and untreated GDM can lead to many complications in the mother, fetus and newborn child. Pregnant women's level of knowledge and awareness is crucial. This applies to diagnostics, glycemic control skills, appropriate lifestyle regulation, as well as the risk assessment of poorly controlled or treated GDM. The pharmacological treatment of hyperglycemia in pregnant women with GDM is based mainly on insulin therapy. In most women with GDM, the course of the disease is mild, which allows for the avoidance of insulin therapy. Nevertheless, in approx. 20–30% of women, insulin is necessary to achieve normoglycemia.[8] The most common guidelines for the treatment of hyperglycemia are a proper diet and physical activity, improving the sensitivity of tissues to insulin and having a beneficial effect on psychophysical fitness.[13]

Objectives

The study aimed to determine the level of awareness of the women diagnosed with GDM, concerning the diagnosis and self-control of diabetes, as well as the risk of poorly controlled or treated GDM. In particular, attention was paid to the women's awareness of self-control and dietary behavior, depending on their age, education, number of pregnancies, and quality of medical care.

Materials and methods

One hundred women diagnosed with gestational diabetes were enrolled in the study. The GDM was diagnosed following the recommendations in force in Poland[1–3,14] and oral glucose tolerance test (75 g) (OGTT). The diagnostic criteria for plasma glucose concentration were consistent with those recommended by the Polish Diabetes Association [mg/dL], that is: the inclusion criteria to the study were the results of the OGTT (75 g) 92–125 (fasting), ≥180 (after 60 min), 153–199 (after 120 min). The criteria for the diagnosis of gestational diabetes based on the OGTT test are described in Fig. 1.

Questionnaire

The study was based on a questionnaire distributed among the surveyed women between January and April

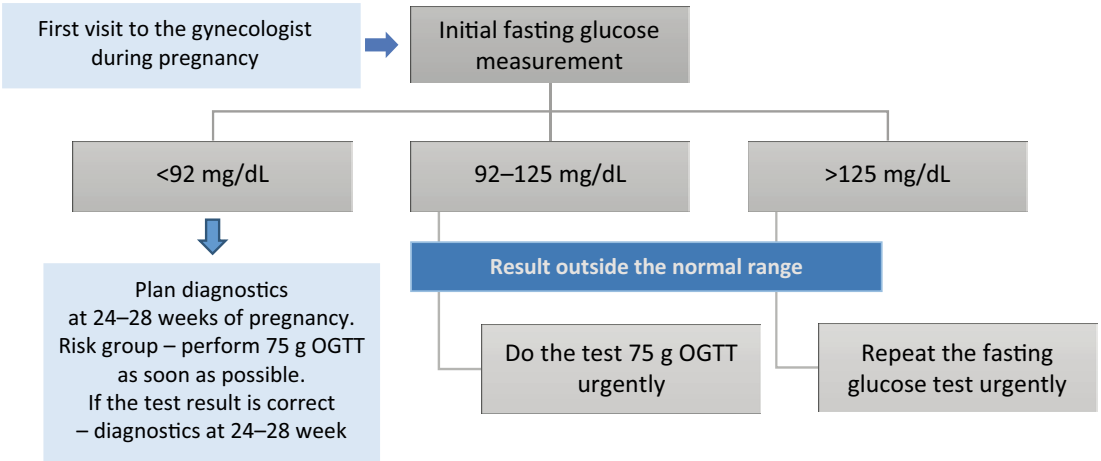

Fig. 1. The criteria for the diagnosis of gestational diabetes based on the oral glucose tolerance test (OGTT)[2,3] (self-modification)

2020. The questions in the survey were divided into 7 parts, depending on the subject of the questions: I – general data concerning age, education and possible previous pregnancies; II – the awareness of the correct values of carbohydrate metabolism; III – the risk of developing diabetes; IV – the risk of GDM for a woman/fetus; V – medical care in pregnancy; VI – self-monitoring and dietary and pharmacological treatment; and VII – change in lifestyle and physical activity.

Statistical analyses

At the beginning of the research procedure, the level of risk awareness and dangers in pregnant women resulting from GDM were assessed. The points considered to be the indicators of the awareness level, awarded for providing the correct answers to the self-questionnaire questions, were summed up. In the case of the multiple-choice questions, points were awarded for not giving incorrect answers. The possible number of earned points was from 0 to 29 points. After the standardization of the results to the value of 100, the percentage of the correct responses was obtained. These results were divided into the following ranges: low level (<66% of the correct answers), average level (66%–80% of the correct answers) and high level (>81% of the correct answers) (Table 1). The percentage of correct answers was used to assess the general awareness of GDM among surveyed women.

To assess the quality of medical care, a new variable was created with 2 categories of responses: better and worse. The respondents who answered "yes" to at least 4 out of 6 questions concerning this area, were considered to be women provided with better medical care.

The level of statistical significance was set at $p < 0.05$. The variables expressed at the ordinal or nominal level were analyzed using χ^2 test. Parametric test (Student's t-test (t)) or its nonparametric equivalents, which compare the medians of the dependent variable in individual groups (Mann–Whitney U (MW) test or Kruskal–Wallis test (KWT)) were used to analyze the quantitative variables by a group. The selection of tests was based on the distribution of the variables, which was verified with the Shapiro–Wilk test (Table 2). The calculations were made in the R v. 3.6.0 statistical environment (R Foundation for Statistical Computing, Vienna, Austria), with the PSPP program (Alberta Pensions Services, Edmonton, Canada; free software supported by the Free Software Foundation, GNU General Public License (GNU GPL) https://www.gnu.org/software/pspp/) and MS Excel 2019 (Microsoft, Redmond, USA).

Results

The study participants were divided into groups depending on their age: 19–24 (16%), 25–34 (63%) and >34 (21%). The vast majority of the women had higher education

Table 1. Descriptive statistics of individual parts of the survey

Parameter	n	M	SD	Min	Max	Q25	Me	Q75
General awareness [points]	100	20.57	4.03	9.00	29.00	18.00	21.00	23.25
General awareness [%]	100	70.92	13.89	31.00	100.00	62.00	72.00	80.00
Correct values of carbohydrate metabolism [points]	100	8.29	1.97	3.00	11.00	7.00	8.00	10.00
Correct values of carbohydrate metabolism [%]	100	75.52	17.91	27.00	100.00	64.00	73.00	91.00
Risk of developing gestational diabetes [points]	100	2.36	1.06	0.00	4.00	2.00	2.00	3.00
Risk of developing gestational diabetes [%]	100	59.00	26.48	0.00	100.00	50.00	50.00	75.00
Risk of GD for a woman/fetus [points]	100	4.67	1.14	1.00	6.00	4.00	5.00	5.00
Risk of GD for a woman/fetus [%]	100	77.78	18.88	17.00	100.00	67.00	83.00	83.00
Medical care in pregnancy [points]	100	3.68	1.68	0.00	6.00	3.00	4.00	5.00
Medical care in pregnancy [%]	100	61.38	27.88	0.00	100.00	50.00	67.00	83.00
Self-monitoring and dietary and pharmacological treatment [points]	100	1.57	0.64	0.00	2.00	1.00	2.00	2.00
Self-monitoring and dietary and pharmacological treatment [%]	100	78.50	1.98	0.00	100.00	50.00	100.00	100.00

n – number; M – mean; SD – standard deviation; Min – minimum; Max – maximum; Q25 – 1st quartile; Me – median; Q75 – 3rd quartile; GD – gestational diabetes.

Table 2. The results of the normal distribution of the studied variables obtained with the Shapiro–Wilk test

Hypothesis	Statistic	p-value
The relationship between age and risk of developing gestational diabetes	0.960	0.004
The relationship between education and normal values of carbohydrate metabolism	0.948	<0.001
The relationship between education and self-control and treatment	0.750	<0.001
The relationship between first or subsequent pregnancy and risk of developing gestational diabetes	0.962	0.005
The relationship between gestational diabetes in a previous pregnancy and normal values of carbohydrate metabolism	0.975	0.534

Table 3. Characteristics of the study group

Parameter	Frequency	Percent
Age		
19–24	16	16.00
25–34	63	63.00
>34	21	21.00
Education		
Primary	1	1.00
Vocational	2	2.00
Secondary	24	24.00
Higher	73	73.00
First pregnancy		
Yes	62	62.00
No	38	38.00
GDM in a previous pregnancy		
Yes	14	14.00
No	24	24.00
Not applicable	62	62.00

GDM – gestational diabetes mellitus.

(73%), 24% secondary, 2% vocational, and 1% primary. Among the surveyed women, 62% were in their first pregnancy, while 14% of the remaining 38% had GDM in the past (Table 3).

First, the relationships between the general awareness of GDM and age, education, number of pregnancies, and the experience of diabetes in the past were examined. However, the individual areas of the respondents' awareness to which the subsequent hypotheses referred to were so detailed that the number of points that could be obtained within each of them indicated relatively small awareness, concerning: correct values of carbohydrate metabolism (11 points), risk of GDM development (4 points), health consequences for woman or fetus (6 points), medical care during pregnancy (6 points), as well as self-control and dietary and pharmacological treatment (2 points). Hence, these areas could not create comparable levels of awareness. Therefore, the analysis was based on the quantified data, i.e., the percentage of the correct answers.

There was no difference in the awareness of the GDM regarding the age of the women, their education (after the removal of minor categories: primary and vocational), the number of pregnancies, and previous GDM in the past (Fig. 2).

However, interesting results were obtained when a detailed analysis of the relationship among the awareness of the correct values of carbohydrate metabolism, the health risks of GDM for the woman and the fetus, medical care during pregnancy, self-control, and dietary and pharmacological treatment, as well as the respondents' age, education and the number of pregnancies

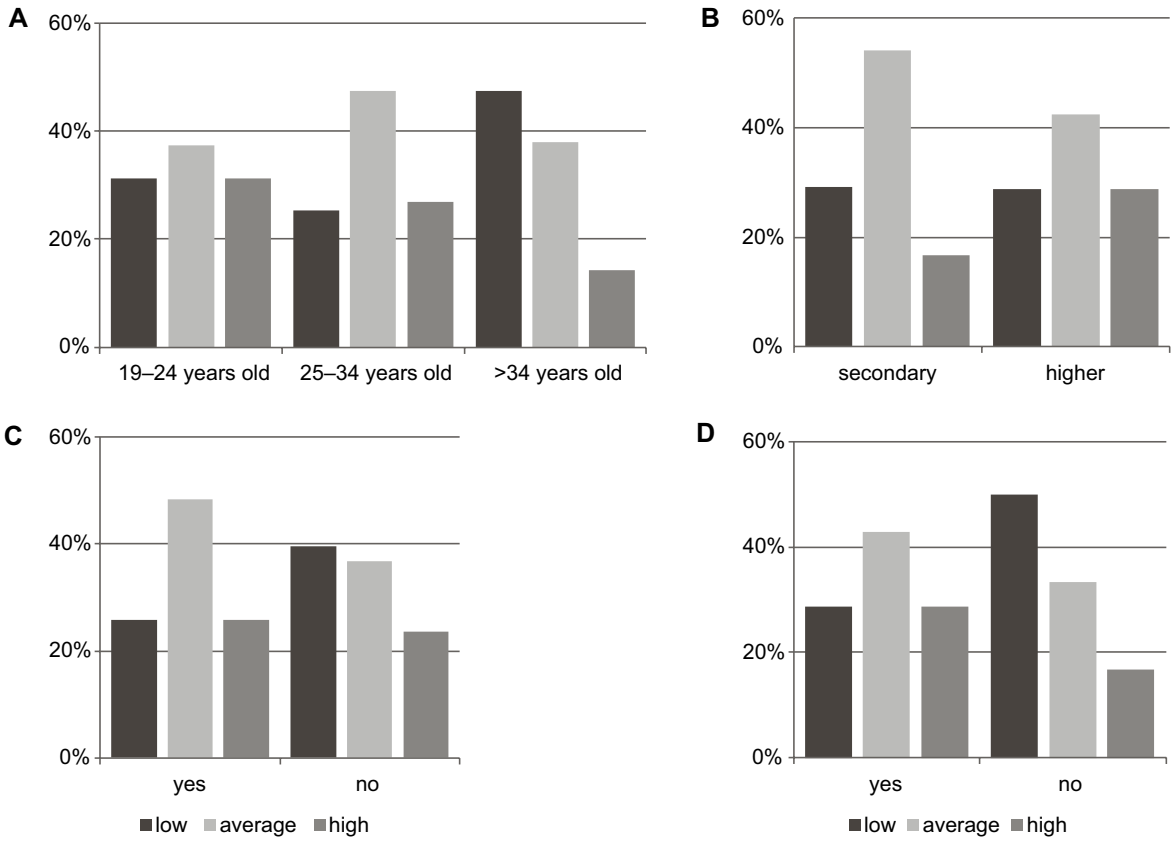

Fig. 2. Relationship between the level of the respondents' general awareness of gestational diabetes mellitus (GDM) and age (A), education (B), the first or subsequent pregnancy (C), and the experience of diabetes in the previous pregnancy (D)

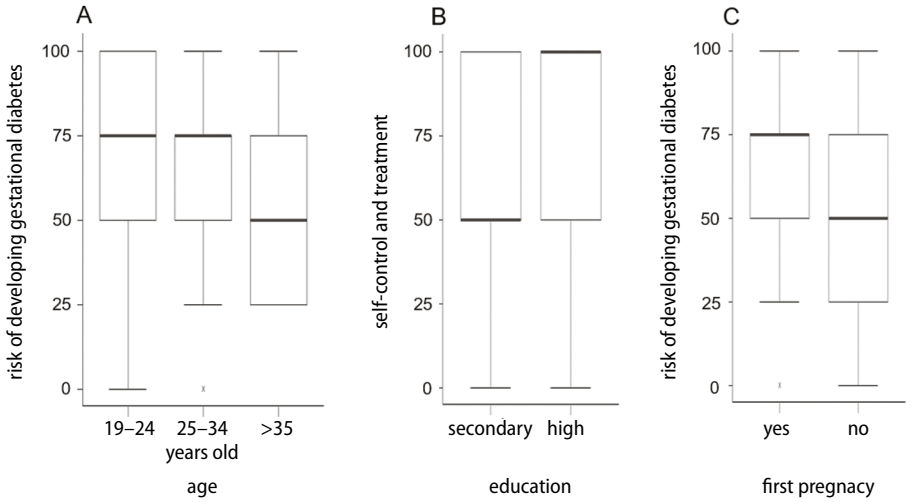

Fig. 3. Relationship between the level of awareness in terms of: A. the risk of developing gestational diabetes and the age of the respondents (Kruskal–Wallis test); B. self-control, treatment and the education of the respondents (Mann–Whitney U test); C. the risk of developing gestational diabetes and the first or subsequent pregnancies of the examined women (Mann–Whitney U test). Box plots show the summary of the data: lower whisker – minimum; central 'box' (lower quartile (Q1), median (Q2) and upper quartile (Q3)); upper whisker – maximum; and outlier (x) – extreme data point

Table 4. Relationship between the awareness of the risk of developing gestational diabetes mellitus (GDM) and the age of the examined women. Results of non-parametric Kruskal–Wallis test

Parameter	Descriptive statistics						
	age [years]	χ^2	df	p-value	Min	Max	Me
Risk of developing gestational diabetes	19–24	6.58	2	**0.037**	0.00	100.00	75.00
	25–34				0.00	100.00	75.00
	>34				25.00	100.00	50.00

df – degrees of freedom; Min – minimum result; Max – maximum result; Me – median. Values in bold are statistically significant.

Table 5. Relationships between the level of the awareness of the risk of developing gestational diabetes and the age of the respondents. Results of non-parametric Kruskal–Wallis test

Parameter	Age groups [years]		p-value
Risk of developing gestational diabetes	19–24	25–34	0.421
	19–24	>34	**0.042**
	25–34	>34	0.312

Values in bold are statistically significant.

(including pregnancies with accompanying GDM) were performed. A statistically significant ($p < 0.05$, KWT) higher level of awareness of the risk of developing GDM was observed among the examined women aged 19–24 compared to those aged >34 (Table 4,5; Fig. 3A). The surveyed women also differed in the level of the awareness of carbohydrate metabolism in a statistically significant way ($p < 0.05$, MW), depending on their education level (Table 6; Fig. 4B). The women with higher education achieved significantly higher results than the respondents with secondary education. A statistically significant ($p < 0.05$, MW) higher level of the awareness of glycemic self-control and adherence to the recommended (dietary or pharmacological) treatment was also observed among the women with higher education compared to the women with secondary education (Table 6; Fig. 3B). The women

Table 6. The relationship between the awareness of the correct values of carbohydrate metabolism and glycemic self-control, adherence to the recommended (dietary or pharmacological) treatment and respondents' education, and between the awareness of gestational diabetes and the respondents' first or subsequent pregnancy. Results of non-parametric Mann–Whitney U test

Dependencies among themselves		U	p-value	Min	Max	Me
Education	Normal values of carbohydrate metabolism	636.50	**0.043**		N/A	
	secondary	N/A		36.00	100.00	73.00
	high	N/A		27.00	100.00	82.00
Education	Self-control and treatment	660.50	**0.031**		N/A	
	secondary	N/A		0.00	100.00	50.00
	high	N/A		0.00	100.00	100.00
First pregnancy	Risk of developing gestational diabetes	838.50	**0.012**		N/A	
	yes	N/A		0.00	100.00	75.00
	no	N/A		0.00	100.00	50.00

Me – median; Min – minimum result; Max – maximum result; N/A – not applicable. Values in bold are statistically significant.

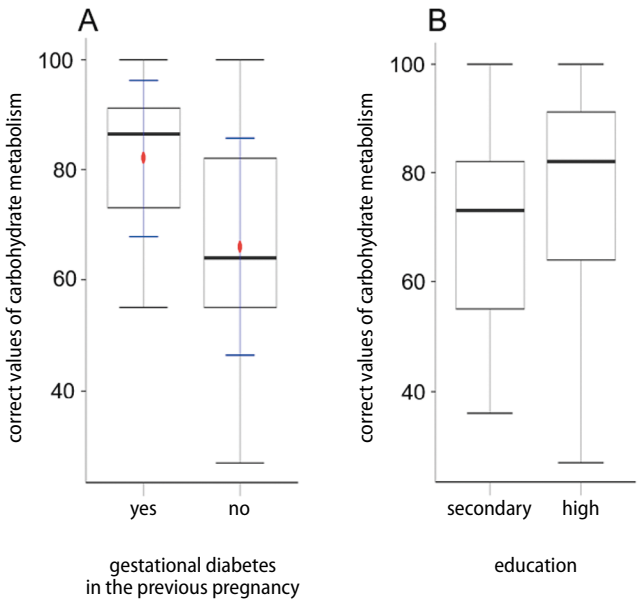

Fig. 4. Relationship between awareness: A. concerning the normal values of carbohydrate metabolism and the experience of diabetes in a previous pregnancy (Student's t-test); Box plots show the summary of the data: lower whisker – minimum, blue transverse line on the lower and upper whisker – standard deviation (SD), central box (mean values are indicated by the red dot symbol (M)); upper whisker – maximum; B. concerning the correct values of carbohydrate metabolism and the education of the respondents (Mann–Whitney U test); Box plots show the summary of the data: lower whisker – minimum, central 'box' (lower quartile (Q1), median (Q2) and upper quartile (Q3)); upper whisker – maximum; and outlier (x) – extreme data point

who experienced GDM in previous pregnancies had a much higher level of knowledge of the correct values of carbohydrate metabolism than the women who had never dealt with diabetes before (p = 0.012, t; Table 7; Fig. 4A). At the same time, in the analysis of the awareness of the pregnant women related to the risk of developing GDM, a statistically higher level of awareness was found among the women giving birth for the first time than among the multiparous women (p = 0.012, MW; Table 6; Fig. 3C). However, the examined women did not differ in the level of awareness in the remaining relationships related to age, education and the number of pregnancies, in a statistically significant way (p > 0.05, MW).

It can also be noticed that 43.8% of the women aged 19–24 years significantly more often did not pay attention to the glycemic index (GI) of products (p = 0.033, χ^2; Table 8; Fig. 5), compared to the women aged 25–34, among whom only 14.3% did not pay attention to the GI, and to the women over 34 years old, among whom only 23% did not pay attention to GI. The impact of the quality of medical care on the type of food consumed was observed. Most women (89.2%) who received better medical care and 60.0% of those who received worse medical care paid attention to the GI of products found in their daily diets. The pregnant women with better medical care significantly more often (p = 0.002, χ^2) noticed the GI of the consumed products (Table 8; Fig. 5). At the same time, the women with varying degrees of education equally often paid attention to the GI of products in their diets. They did not differ in physical activity in different age and education groups. Their number of training units per week was similar, and their level of lifestyle changes due to GDM did not differ statistically (p > 0.05, χ^2).

Discussion

The aim of the study was to assess the level of the women's awareness concerning various health aspects resulting from the diagnosis of GDM. It may be noted that the percentage of women with a high level of awareness

Table 7. Relationship between gestational diabetes mellitus (GDM) awareness and previous pregnancy diabetes experience. Results of parametric Student's t-test

Parameter		t	df	p-value	M	SD
Normal values of carbohydrate metabolism		2.6	36	0.012	N/A	
Gestational diabetes in a previous pregnancy	yes	N/A			82.00	14.12
	no	N/A			66.04	19.68

df – degrees of freedom; M – mean; SD – standard deviation; N/A – not applicable. Values in bold are statistically significant.

Table 8. Relationship among lifestyle changes and physical activity in pregnancy and the age of the respondents and the quality of medical care in pregnancy. Results of the χ^2 test

Parameter			Age [years]			Medical care	
			19–24	25–34	>34	better	worse
Paying attention to the glycemic index of products found in the daily diet	yes	n	9	54	16	58	21
		%	56.3	85.7	76.2	89.2	60
	no	n	7	9	5	7	14
		%	43.8	14.3	23.8	10.8	40
Results of the test			χ^2 = 6.803, df = 2, **p = 0.033;** χ^2 = 10.021, df = 1, **p = 0.002**				

df – degrees of freedom; p – p-value. Values in bold are statistically significant.

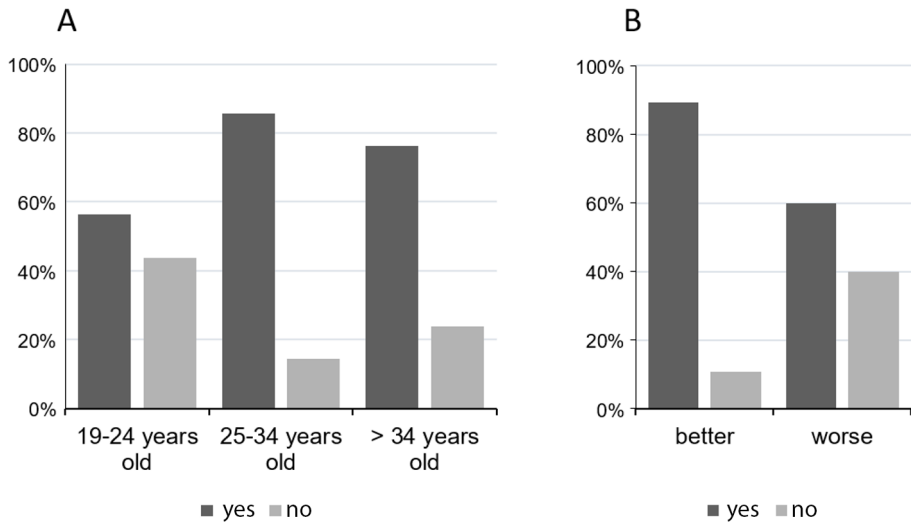

Fig. 5. Relationship between paying attention to the glycemic index and A. the age of the pregnant women, B. the level of medical care

decreases with age. With increasing age, the society spends less and less time on education, whereas the age of 19–24 is one of the most intensive stages of learning, which may be the reason for the increased awareness in this group of the surveyed women. The study participants of >34 years of age may use outdated knowledge, which may also be the reason for the smaller number of the women with a high level of awareness in this group. Higher education determined the greater percentage of the women with a high level of awareness compared to the pregnant women with secondary education. Nevertheless, no statistically significant relationship was found between the respondents' level of awareness and their education. Although the result is not statistically significant, the difference is noticeable. The results showed no correlation between the number of experienced pregnancies and the level of general awareness of GDM. We have also noticed a difference in the low level of awareness between the 1st and 2nd or subsequent pregnancies. There were significantly fewer women giving birth for the first time with a low level of awareness than the women giving birth in the past. This suggests that the level of the women's awareness of metabolic complications in pregnancy does not increase with the potential experience and the practically acquired knowledge related to the experience of earlier pregnancy. The experience of gestational diabetes in a previous pregnancy resulted in a slightly higher level of women's awareness, compared to the respondents who did not experience GDM. Worth noting is the result related to the high number of pregnant women having a low level of awareness; they were not burdened with GDM in a previous pregnancy.

Similar research using the questionnaire had already been carried out in the world before in such countries as Australia, India and Samoa.[15–17] The authors of these studies pointed to the need for education in order to improve the awareness of GDM. In 2019, the questionnaire was used in India as a research method to examine 523 pregnant women.[18] Thomas et al. drew attention to the need for raising women's awareness and knowledge of GDM, as it may have an impact on identifying the disease at an earlier stage and thus reducing its effects on the mother and child.[18] A similar study was carried out in 2019 in Norway (in the Oslo region) among 238 pregnant women in a multiethnic population, out of which 108 (45.4%) were native speakers of Norwegian, while 130 (54.6%) were from Asia, Africa and Eastern Europe. Based on a survey conducted in 3 languages (Norwegian, Urdu and Somali), the authors focused on the issue of the language barrier, as native Norwegian women had a much greater understanding of GDM compared to the women from other ethnic groups. However, they noticed a more significant correlation between poor knowledge of GDM and low education, regardless of the ethnic group.[19] The results of the surveys on various aspects of the women's awareness of GDM carried out in different countries confirm the outcomes observed in our study. However, in some aspects, the obtained results were surprising.

Based on the detailed results of our study, we have observed that the women aged 19–24 years had a much higher level of the awareness of the risk associated with the development of carbohydrate disorders during pregnancy than the women >34 years old. In recent years, more and more preventive measures have been used. A great emphasis is placed on the risk factors influencing metabolic disorders, including GDM, such as obesity, overweight or polycystic ovary syndrome. Articles and programs related to pregnancy, in which GDM is discussed, appear increasingly in social media and press. The women aged 19–24 have a potentially greater interest in the topic of pregnancy, and therefore they have a greater understanding of the risk of GDM. Contradicting studies were obtained by Thomas et al., who showed a positive relationship between the knowledge and awareness of DGM and age.[18]

The women with higher education were characterized by a higher awareness of the correct values of carbohydrate metabolism as well as self-control, dietary and

pharmacological treatment, because of their generally greater common knowledge. Some of them may have been professionally related to medical faculties, which determines more extensive medical knowledge and increased awareness of metabolic disorders.

Similarly, women who were pregnant for the first time were much more aware of the risk of developing GDM. Perhaps, it is related to the new situation and the desire to broaden their knowledge on the physiology of pregnancy. Hence, the women in the 2nd or subsequent pregnancy might have not updated or expanded their previously acquired knowledge. For this reason, their level of awareness was significantly lower. Again, the obtained results went against those obtained by Thomas et al.,[18] as in their study the number of pregnancies and the advancement of those pregnancies correlated positively with the level of awareness of GDM.

However, women who have experienced GDM in a previous pregnancy know more about the normal carbohydrate metabolism values. Experienced with GDM in their first pregnancy, they had to become familiar with the carbohydrate metabolism values in order to control GDM properly. Practicing GDM control in their first pregnancy, they became well-acquainted with the norms and proper values of blood glucose. The knowledge of the abovementioned issue was assimilated practically, so the level of its awareness was higher. The obtained results were similar to those obtained by the other researchers, which showed higher knowledge of GDM in women who experienced GDM in a previous pregnancy. This was confirmed by the fact that the pregnant women participating in the study who had a history of diabetes in their families, had broader knowledge of various aspects of GDM than those who did not. Electronic and written media are the primary tools to raise the level of knowledge of GDM.[18]

We have searched for a relationship between the surveyed women's changes in lifestyle and physical activity, as well as between the women's age and education. The age of women was statistically significant in terms of the control of products consumed during pregnancy with GDM, with less attention paid to this issue among the youngest group. The results may be linked to a very intensive lifestyle, a lack of knowledge of GI of products and no involvement in preparing meals, as well as low awareness of the proper diet in GDM. There was no significant correlation between education and lifestyle changes as well as physical activity.

The study also investigated the relationship between the change in lifestyle, including physical activity and the first or subsequent pregnency. We also looked at the relationship between lifestyle changes and GDM in a previous pregnancy. The majority of the women from all groups declared a change in lifestyle after becoming pregnant. Changing lifestyle and physical activity is one of the most crucial aspects of pregnancy. Most of the women tried to adapt their lifestyle to the situation, but – unfortunately – their physical activity was limited. Meanwhile, they should often decide to introduce their daily physical activity, which significantly impacts the improvement of metabolic disorders such as GDM.

It was observed that the women with high awareness changed their lifestyle more often; this concerns the quality of meals, resulting from the analysis of the GI and physical activity introduced into the daily or weekly schedule. The obtained results prove the importance of prophylaxis, broadening the knowledge of the women through various types of campaigns and improving the access to the current knowledge of the areas related to GDM.

The last topic discussed in this study was the relationship between the quality of medical care in pregnancy and the awareness of proper self-control, dietary or pharmacological treatment, and lifestyle change. Generally, women provided with better medical care significantly more often paid attention to the quality of products consumed in their daily diets and declared daily physical activity much more frequently than in the case of the worse level of healthcare. The level of medical care seemed to be very important in terms of activity related to lifestyle changes. Thus, numerous social programs aimed at increasing medical care in pregnancy should be carried out, as this might result in a higher awareness of pregnant women with GDM, and at the same time limit the health risk to a pregnant woman and the fetus.

Limitations

The main limitations are the restriction to the Polish population and the relatively small study group. Our results indicate the need for further research that would allow for more accurate identification of the causes of low awareness concerning GDM of women.

Conclusions

The results emerging from this study provide a perfect basis for conducting further research in a given direction, as they highlight many dependencies that can potentially influence the awareness of various aspects related to GDM, especially the results obtained for the quality of medical care.

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