Neuroendocrinology Letters Volume 38 No. 6 2017
ISSN: 0172-780X; ISSN-L: 0172-780X; Electronic/Online ISSN: 2354-4716
Web of Knowledge / Web of Science: Neuroendocrinol Lett
Pub Med / Medline: Neuro Endocrinol Lett

New criteria for gestational diabetes mellitus – do they impact the outcome?

Julia Zaręba-Szczudlik [1], Dominika Pykało-Gawińska [2], Cieszymierz Gawiński [2], Zbigniew Lewandowski [3], Aneta Malinowska-Polubiec [1], Agnieszka Dobrowolska-Redo [1], Krzysztof Czajkowski [1], Jan Wilczyński [1], Ewa Romejko-Wolniewicz [1]

1 2nd Department of Obstetrics and Gynecology, Medical University of Warsaw, Poland
2 Students' Scientific Group next to 2nd Department of Obstetrics and Gynecology, Medical University of Warsaw, Poland
3 Department of Epidemiology, Medical University of Warsaw, Poland

Correspondence to: Ewa Romejko-Wolniewicz, MD., PhD.
2nd Department of Obstetrics and Gynecology, Medical University of Warsaw,
ul. Karowa 2, 00-315 Warsaw.
tel: +48 507097063; fax: +48 225966487; e-mail: ewamariar@wp.pl

Submitted: 2017-08-19 Accepted: 2017-09-11 Published online: 2017-12-10

Key words: **gestational diabetes mellitus; pregnancy; glucose level; oral glucose tolerance test; body mass index**

Neuroendocrinol Lett 2017; **38**(6):441–448 **PMID:** 29298286 NEL380617A09

Abstract

OBJECTIVE: The aim of the study was to compare the perinatal outcome of pregnancies in mothers who were diagnosed with gestational diabetes mellitus (GDM) with previous versus current Polish Gynecological Society (PTG) criteria.
METHODS: 475 patients were divided into three groups. In group A, the patients only met the previous PTG criteria for a GDM diagnosis, i.e., those with a blood glucose level of 140–152 mg/dl 2 hours after administration, a fasting glucose level <92 mg/dl, and a blood glucose level <180 mg/dl 1 hour after administration. Group B included patients complying with both the previous and current PTG criteria for a GDM diagnosis. Group C included patients who only met the current PTG criteria for a GDM diagnosis, i.e., those with a fasting blood glucose level of 92–99 mg/dl, a blood glucose level <180 mg/dl 1 hour and <140 mg/dl 2 hours after administration, respectively.
RESULTS: Women from group C were characterized by the highest fasting glycaemia in the first trimester of pregnancy (93.0 mg/dL vs. 88.0 mg/dL vs. 83.5 mg/dL, p=0.012) and during the OGTT (p=0.001). Gestational diabetes was diagnosed significantly earlier in patients from group C (23 vs. 26 vs. 26 weeks, p=0.005). The patients from group A significantly less frequently required insulin therapy for proper glycemic control (p=0.035). Women from group A were characterized by lower pre-pregnancy BMI (p=0.001).
CONCLUSIONS: Current PTG criteria for diagnosing GDM according to the IADPSG allow for identification of women who often require insulin therapy to achieve proper glycemic control.

ORIGINAL ARTICLE

Abbreviations:

ACOG	- American College of Obstetricians and Gynecologists
ADA	- American Diabetes Association
ADIPS	- Australasian Diabetes in Pregnancy Society
ASD	- atrial septal defect
BMI	- body mass index
GDM	- gestational diabetes mellitus
HAPO	- Hyperglycaemia and Adverse Pregnancy Outcome
IADPSG	- International Association of Diabetes and Pregnancy Study Groups
LGA	- large for gestational age
OGTT	- oral glucose tolerance test
PTD	- Diabetes Poland
PTG	- Polish Gynecological Society
SGA	- small for gestational age
SMFM	- Society for Maternal – Fetal Medicine
VSD	- ventricular septal defect
WHO	- World Health Organization

INTRODUCTION

Gestational diabetes mellitus (GDM) is a hyperglycemic condition that is detected for the first time during pregnancy in previously healthy women (Metzger & Coustan 1998). It occurs in 2–5% of pregnant women and is a growing problem (Polish Gynecological Society 2014). According to the survey conducted by the Polish Ministry of Health in 2010 GDM occured in 4% of pregnant women in Poland (Kopacz *et al.* 2011).

For years, there were no uniform criteria for diagnosing gestational diabetes. Depending on the scientific association guidelines, there has been a different system of diagnosis. American College of Obstetricians and Gynecologists (ACOG) recommended a two-step approach with a 50 g 1-hour screening step and, if positive, a 100 g, 3-hour oral glucose tolerance test (OGTT) with two elevated value required for the diagnosis (ACOG 2001); American Diabetes Association (ADA) recommended either the above two step approach or a one-step approach using a 75 g, 2-hour OGTT with one or more elevated values required (ADA 2004); World Health Organization (WHO) recommends the above 75 g, 2-hour OGTT (World Health Organization 1999). The Polish approach until June 2014 consisted of a 75 g, 2-hour OGTT with cutoffs of 100 mg/dL, 180 mg/dL and 140mg/dL at fasting, 1 and 2 hours, respectively, with one or more elevated values required (Polish Gynecological Society 2011).

In 2008, the results of the HAPO (Hyperglycaemia and Adverse Pregnancy Outcome) study were published, which was the first international, multi-center attempt to analyze the relationship between maternal glycaemia and perinatal outcomes. It was performed to revise the criteria for diagnosing gestational diabetes and adjust the threshold value of blood glucose to identify women with a higher risk of pre-eclampsia; preterm delivery (less than 27 weeks of pregnancy); delivery of a newborn with a weight above the 90th percentile, shoulder dystocia, or perinatal injury; termination of pregnancy by a caesarean section; neonatal hyperglycemia; hyperbilirubinemia in the newborn; fetal hyperinsulinemia (C-peptide level in cord blood above the 90th percentile); and the need for neonatal intensive care (Lowe *et al.* 2012).

Based on the results of the HAPO study, in 2010 the International Association of Diabetes and Pregnancy Study Groups (IADPSG) established the following new diagnostic criteria for gestational diabetes when diagnosed on the basis of a 75 g glucose load test (OGTT): a fasting glucose level ≥92 mg/dL; a glucose level 1 hour ≥180 mg/dL after administration; a glucose level ≥153 mg/dL 2 hours after administration (International Association of Diabetes and Pregnancy Study Groups 2010). These criteria have been generally accepted and they have been recommended by the ADA since 2010 (American Diabetes Association 2010), ACOG since 2011 (American College of Obstetricians and Gynecologists 2013), WHO since 2013 (World Health Organization 2013) and PTG since June 2014 (Polish Gynecological Society 2014).

The aim of the study was to compare the perinatal outcome of pregnancies in mothers who were diagnosed with gestational diabetes mellitus according to different criteria with special consideration for the pregnancy complications, mode of delivery and neonatal complications. Regarding the change in the criteria for a gestational diabetes diagnosis over the last few years, we can divide the group of women with gestational diabetes into the following categories: women who were diagnosed with the disease according to the previous PTG criteria, while according to the new criteria they would be considered healthy; women who were diagnosed with gestational diabetes according to both previous and current PTG criteria; and women who were considered healthy according to the previous PTG criteria, while they were diagnosed with the disease according to the current PTG criteria.

MATERIALS AND METHODS

The study included 475 women with a single pregnancy who were diagnosed with gestational diabetes, hospitalized and gave birth in the 2nd Department of Obstetrics and Gynecology of the Medical University of Warsaw from the 1st of January 2013 to 27th of December 2015.

Gestational diabetes was diagnosed according to the guidelines of PTG.

All pregnant women are evaluated for dysglycemia. Initial fasting blood glucose measurement to detect undiagnosed pre-pregnant diabetes or glucose intolerance is ordered early during pregnancy, at the time of the first visit to a gynecologist. In pregnant women at risk (particularly body mass index (BMI) ≥30 kg/m^2, gestational diabetes during previous pregnancies, history of glucose intolerance), a diagnostic test (OGTT with 75 g of glucose) is ordered at the time of the first visit during pregnancy. If blood glucose is normal (fasting glucose

level <92 mg/dL), the diagnostic test should be repeated between 24 and 28 weeks of gestation or in case of symptoms suggesting diabetes. If it is 92–125 mg/dL, OGTT must be performed as soon as possible. If the fasting glucose turns out to be ≥126 mg/dL a test must be repeated as soon as possible. If the second result is still ≥126 mg/dL, the patient is diagnosed with diabetes mellitus during pregnancy and has to be transferred to reference center immediately. If the second result is <126 mg/dL, OGTT should be performed.

In case of random blood glucose ≥200 mg/dL GDM is diagnosed, the patient have to be transferred to the reference center immediately, OGTT must not be performed (Polish Gynecological Society 2014).

According to Diabetes Poland (PTD) women with following risk factors: pregnancy beyond 35 years of age, history of macrosomia (birth weight >4 000 g), previous delivery of a neonate with a congenital anomaly, history of intrauterine fetal demise, hypertension, overweight or obesity, family history of diabetes type 2, gestational diabetes during previous pregnancies, multiparty, polycystic ovary syndrome, should have OGTT performed during first prenatal visit (Diabetes Poland 2016).

Between 24 and 28 weeks of gestation, single-step diagnostic investigation is performed using OGTT in accordance with the standards of the PTG and PTD. They include measuring the fasting glucose level in venous plasma after an overnight fast (8–14 hours), drinking a solution of 75 g of glucose dissolved in 250–300 ml of water within 5 minutes, and measuring the glucose level in venous plasma 1 and 2 hours after administration, while the pregnant women are at rest. Enzymatic UV test (hexokinase method) for the quantitative determination of glucose was used in our study (Sacks *et al.* 2011).

In Poland, the guidelines for diagnosing gestational diabetes were changed in June 2014. The old guidelines included a fasting level of glucose ≥100 mg/dL, a level of glucose ≥180 mg/dL 1 hour after administration, and a level of glucose ≥140 mg/dL 2 hours after administration. The current guidelines for diagnosing gestational diabetes according to the HAPO results include a fasting level of glucose ≥92 mg/dL; a level of glucose ≥180 mg/dL 1 hour after administration, and a level of glucose ≥153 mg/dL 2 hours after administration.

After diagnosis of GDM all patients are treated with diet (GDMG1) and perform self-glucose monitoring at least 4 times a day (fasting, 1 hour postprandial glucose level after main meals). Patients with fasting glucose levels ≥90 mg/dL or postprandial glucose levels ≥120 mg/dL in self-monitoring for at least 7 days had insulin treatment introduced (GDMG2). Patients with GDM2 should also monitor glucose level at night to prevent episodes of hypoglycemia (Polish Gynecological Society 2011).

The patients were divided into three groups. In group A, the patients only met the previous PTG criteria for a gestational diabetes diagnosis, i.e., those with a blood glucose level of 140–152 mg/dL 2 hours after administration, a fasting glucose level <92 mg/dL, and a blood glucose level <180 mg/dL 1 hour after administration. Group B included patients complying with both the previous and current PTG criteria for a gestational diabetes diagnosis, i.e., those in whom at least one of the following glucose level was detected: a fasting glucose level ≥92 mg/dL, a blood glucose level ≥180 mg/dL 1 hour after administration, or a blood glucose level ≥153 mg/dL 2 hours after administration. Group C included patients who only met the current PTG criteria for a gestational diabetes diagnosis, i.e., those with a fasting blood glucose level of 92–99 mg/dL, a blood glucose level <180 mg/dL 1 hour after administration, or a blood glucose level <140 mg/dL 2 hours after administration.

These groups of women were compared in terms of age, parity, marital status, level of education, type of work, place of residence and anthropometric indices (pre-pregnancy BMI, body weight gain during pregnancy and abdominal circumference measured at the navel before delivery).

The week of pregnancy was recorded when gestational diabetes was diagnosed. In addition, the levels of fasting glucose during the first trimester of pregnancy, the level of glucose in OGTT, the percentage of patients with diabetes treated with diet and insulin, the percentage of patients who were diagnosed with pre-pregnancy hypertension or pregnancy-induced hypertension, the week of labor, the method of delivery (spontaneous vaginal delivery, operative vaginal delivery, scheduled caesarean section, or caesarean section during delivery), the occurrence of shoulder dystocia and the occurrence of serious perinatal injuries (perineal tear of grade 3 or 4, vaginal ruptures, injuries of urinary tracts, symphysis pubic diastasis, and uterine rupture) were also recorded for comparison.

The groups were also compared in terms of the baby's sex, ultrasound estimated fetal weight, newborn birth weight, percentage of newborns with a birth weight >90th percentile – large for gestational age – LGA (Pietrzak & Krasomski 2007), macrosomia (>4 000 g), birth weight <10th percentile – small for gestational age – SGA (Pietrzak & Krasomski 2007), and hypotrophy (<2 500 g). Moreover, the head circumference, thorax widths and head circumference – thorax width ratio of newborns were compared. The percentages of newborns who were born in good general condition (scoring 8–10 points in the Apgar score in the 5th minute of life), average condition (4–7 points) and severe condition (0–3 points) and the percentages of newborns with perinatal injuries, perinatal hypoxia, birth defects and perinatal deaths were compared. The analysis included the following postnatal complications: hypoglycemia (<40 mg/dL glucose level) and hyperbilirubinemia (>12 mg/dL bilirubin level). All neonates where monitored for glucose and bilirubin levels by a standard protocol.

The Ethics Committee of the Medical University of Warsaw approved the study protocol.

Statistics

The quantitative (measurable) results of three groups were compared with Kruskal-Wallis test, which determines only one level of significance, in order to exclude the problem of multiple comparisons. One level of significance when comparing three groups does not precise the groups which the statistically significant difference concern. To solve this problem (if the Kruskal-Wallis test level of significance was lower than 0.05), Wilcoxon test was used. Also Fischer test, U-Mann-Whitney test, analysis of variance test and Student's t test were used for comparisons of qualitative and quantitative parameters.

The statistical analysis was performed using the SAS 10 program (SAS/STAT 9.3, User's Guide 2011, Volume 1, 2, 3, SAS Institute Inc., Cary, NC, USA).

RESULTS

Of 475 women, 61 were classified into group A, 396 into group B and 18 into group C. The characteristics of mothers and data regarding delivery are presented in Table 1. The groups did not differ in terms of age, parity or socioeconomic status. Women from group A were characterized by lower pre-pregnancy BMI as well as a smaller abdominal circumference during delivery, although their weight gain during pregnancy was higher than the women in other groups (Table 1).

Women from group C were characterized by the highest fasting glycaemia in the first trimester of pregnancy (93.0 mg/dL vs. 88.0 mg/dL vs. 83.5 mg/dL, p=0.012) and during the OGTT (95 mg/dL vs. 89 mg/dL vs. 79 mg/dL, p=0.001). After both one and two hours following the administration of 75 g of glucose, the patients in group B had higher glycemia than the remaining patients (p=0.001), and those from group C had lower glycemia than the other patients (p=0.001). Gestational diabetes was diagnosed significantly earlier in patients from group C (23 weeks vs. 26 weeks vs. 26 weeks, p=0.005). The patients from group A significantly less frequently required insulin therapy for proper glycemic control (p=0.035). There were no differences among groups regarding the frequency of hypertension occurrence in women.

The patients from group C delivered later than women from groups A and B (39.2 weeks of pregnancy vs. 38.4 weeks of pregnancy vs. 38.4 weeks of pregnancy, p=0.034), but the course of delivery did not significantly differ among the groups. No patient was diagnosed with shoulder dystocia, and no serious perinatal injuries were found in the mothers.

The groups did not differ in terms of the newborn sex or frequency of newborn complications (Table 2). The newborns of mothers from group A were characterized by a lower estimated fetal weight in ultrasound (p=0.024) and newborn birth weight (p=0.015), although the groups did not differ in terms of the frequency of macrosomia, LGA, hypotrophy and SGA occurrence or in terms of the measurement of the head and thorax circumference and relationship of those measurements.

Children of women from group A were more likely to have birth defects (13.1% vs. 4% vs. 5.6%, p=0.021). In all groups, the most frequent defects were heart defects and the most common of these were ASD and VSD.

The state of newborns concerning the Apgar score did not differ significantly among the groups. No hypoxia or injuries during delivery were found in the newborns of mothers from groups A and C. In group B, perinatal injuries (the most common of which were skin abrasion, cephalhematoma, and broken collarbone) were found in eight newborns, and perinatal hypoxia (pH of cord blood 7.08 and 7.03) was found in two newborns. In any group, there was no stillbirth, intranatal newborn death or death of newborns up to 7 days after delivery.

DISCUSSION

The change in the criteria for diagnosing gestational diabetes by IADPSG aimed to reduce the maternal-fetal mortality associated with hyperglycemia by facilitating the identification of patients who are at an increased risk of perinatal complications (Oriot *et al.* 2014).

Our study indicates that the population of patients complying to only current IADPSG criteria for diagnosing GDM is different from the population of patients complying with the previous ones in terms of anthropometric indices, levels of fasting glycemia in the first trimester of pregnancy and OGTT, gestational age when GDM is diagnosed, gestational age at delivery, newborn birth weight and percentage of the occurrence of birth defects in newborns.

We found that women diagnosed only with the current PTG criteria were characterized by a significantly higher average BMI before pregnancy (26.6 kg/m^2) compared to those diagnosed only with the previous PTG criteria (22.3 kg/m^2). Our patients also differed in terms of the average weight gain during pregnancy. The group diagnosed only with the previous PTG criteria had a significantly higher weight gain during pregnancy than the group diagnosed with both the previous and current PTG criteria (11 kg vs. 9 kg). The lowest average weight gain during pregnancy was observed in patients from the group diagnosed only with current PTG criteria, although the result was not statistically significant, which may result from the weight gain during pregnancy for each patient (4–16 kg) and the size of the group. It is worth mentioning that the weight gain during pregnancy in all groups maintained an inverse relationship with respect to patients' BMI before pregnancy, which is consistent with the current guidelines

Tab. 1. Maternal characteristics and delivery data.

Variable [unit]	A med (Q_1–Q_3) or n (%) n=61	B med (Q_1–Q_3) or n (%) n=396	C med (Q_1–Q_3) or n (%) n=18	*p*-value A vs B	*p*-value A vs C	*p*-value B vs C	*p*-value
Age [years]	31 (29.0–36.0)	32 (30.0–36.0)	31.5 (30.0–36.0)	ns	ns	ns	ns
Multiparity	52.5%	54.6%	66.0%	ns	ns	ns	ns
Marital status:							
Unmarried	6.8%	10.3%	11.1%				
Married	88.1%	86.9%	83.3%				ns
Other	5.1%	2.8%	5.6%				
Educational level:							
Elementary	0%	1.3%	0%				
Secondary	19.0%	20.8%	22.2%				ns
Tertiary	74.1%	75.6%	72.2%				
Technical college	6.9%	2.3%	5.6%				
Type of work:							
Physical	15.3%	13.7%	5.6%				
Intellectual	76.3%	80.7%	88.9%				ns
Unemployed	8.5%	5.6%	5.6%				
Place of residence:							
Rural	19.7%	19.7%	11.1%				
Urban (<50 000)	27.9%	30.1%	38.9%				ns
City (>50 000)	52.5%	50.3%	50.0%				
Anthropometric parameters:							
Pre-pregnancy BMI [kg/m^2]	22.3 (20.2–24.6)	24.7 (21.8–28.8)	26.6 (23.8–30.5)	0.001	0.002	ns	0.001
Gestational weight gain [kg]	11.0 (7.0–14.0)	9.0 (6.0–13.0)	8.8 (4.0–16.0)	0.032	ns	ns	ns
Abdominal circumference [cm]	100.0 (95.0–105.0)	103.0 (98.0–110.0)	104.0 (99.0–107.0)	0.016	ns	ns	0.05
1st trimester FGL [mg/dL]	83.5 (80.5–87.5)	88.0 (81.0–93.5)	93.0 (85.0–99.0)	ns	0.004	0.032	0.012
OGTT glucose level [mg/dL]:							
FGL	79.0 (74.0–83.0)	89.0 (80.0–97.0)	95.0 (93.0–96.0)	0.001	0.001	0.006	0.001
1 h	152.0 (146.0–165.0)	183.0 (163.0–196.0)	139.0 (121.0–168.0)	0.001	ns	0.001	0.001
2 h	146.0 (143.0–149.0)	157.0 (143.5–169.0)	111.0 (105.0–122.0)	0.001	0.001	0.001	0.001
GA at diagnosis of GDM [weeks]	26 (24–28)	26 (22–28)	23 (12–27)	ns	0.012	0.035	0.05
GDMG1	88.5%	75.3%	66.7%	0.022	ns	ns	0.035
PPH	8.2%	11.1%	5.6%	ns	ns	ns	ns
PIH	4.9%	6.6%	0%	ns	ns	ns	ns
GA at delivery [weeks]	38.4 ± 1.7	38.4 ± 1.5	39.2 ± 1.0				0.034
Spontaneous vaginal delivery	57.4%	58.8%	61.1%	ns	ns	ns	ns
Operative vaginal delivery	3.3%	2.5%	0%	ns	ns	ns	ns
Cesarean section:	36.1%	38.1%	38.9%	ns	ns	ns	ns
Elective	23.0%	27.0%	22.2%	ns	ns	ns	ns
Emergency	14.8%	11.9%	11.1%	ns	ns	ns	ns

OGTT–75 g oral glucose tolerance test, GA–gestational age, GDM–gestational diabetes mellitus, GDMG1–diet controlled gestational diabetes mellitus, PPH–pre-pregnancy hypertension, PIH–pregnancy induced hypertension, and FGL–fasting glucose level

(Siega-Riz *et al.* 2010). In the international medical literature, data on the ratio of the BMI in women with GDM diagnosed according to the former and current criteria are contradictory. An increased percentage of obese patients among those diagnosed according to the IADPSG criteria compared to those diagnosed according to the ADIPS (The Australasian Diabetes Pregnancy Society) criteria was observed; according to ADIPS,

Tab. 2. Neonatal characteristics.

Variable [unit]	A med (Q_1–Q_3) or n (%) n=61	B med (Q_1–Q_3) or n (%) n=396	C med (Q_1–Q_3) or n (%) n=18	*p*-value A vs B	*p*-value A vs C	*p*-value B vs C	*p*-value
Sex – female	57.4%	48.0%	44.4%	ns	ns	ns	ns
EFW [g]	3000 (2643–3500)	3260 (2900–3550)	3247 (3100–3684)	0.017	0.018	ns	0.024
Birth weight [g]	3250 (2980–3500)	3400 (3095–3690)	3540 (3380–3290)	0.029	0.007	ns	0.015
LGA	6.6%	12.4%	5.6%	ns	ns	ns	ns
Macrosomia	0%	4.6%	5.6%	ns	ns	ns	ns
SGA	11.5%	6.1%	11.1%	ns	ns	ns	ns
Hypotrophy	4.9%	2.0%	0%	ns	ns	ns	ns
Hypoglycemia	11.5%	7.6%	5.6%	ns	ns	ns	ns
Hyperbilirubinemia	37.7%	32.1%	44.4%	ns	ns	ns	ns
Congenital defects	13.1%	4.0%	5.6%	0.008	ns	ns	0.021
HC [cm]	34.0 (33.0–35.0)	34.0 (33.0–35.0)	34.0 (34.0–36.0)	ns	ns	ns	ns
CHC [cm]	33.0 (32.0–34.0)	34.0 (32.0–35.0)	34.0 (33.0–35.0)	0.05	ns	ns	ns
HC/CHC ratio	1.03 (1.00–1.06)	1.03 (1.00–1.06)	1.03 (1.00–1.06)	ns	ns	ns	ns
5^{th} min Apgar score							
≤ 7	1.6%	0.8%	0%				ns
8–10	98.4%	99.2%	100%				ns

EFW–estimated fetal weight, LGA–large for gestational age, SGA–small for gestational age, HC–head circumference, and CHC–chest circumference

GDM is diagnosed for fasting glycemia >5.5 mmol/L or a level of 8.0 mmol/L 2 hours after administration of 75 g of glucose (Laafira *et al.* 2016). This result is consistent with our results. Patients diagnosed according to the Carpenter-Coustan criteria (GDM is diagnosed when fasting glycemia >95 mg/dl, >180 mg/dl after 1 hour, >155 mg/dl after 2 hours, or >140 mg/dl 3 hours after administration of 100 g of glucose) were characterized by a higher BMI before pregnancy than those who were diagnosed according to the IADSPG criteria, but that result was not statistically significant (Duran *et al.* 2014).

In our study, gestational diabetes was diagnosed significantly earlier in the group diagnosed only with current PTG criteria compared to the remaining participants (23 weeks vs. 26 weeks). One important observation was that patients in that group were characterized by a higher BMI and being overweight, obese and or extremely obese before pregnancy increased the risk of gestational diabetes (2.1; 3.6; and 8.6 times, respectively) (Chu *et al.* 2007). According to the aforementioned data as well as the recommendations of the PTG, the OGTT has to be recommended for overweight or obese pregnant patients at the very first appointment (Diabetes Poland 2016). Moreover, women who were only diagnosed with current PTG criteria were characterized by a higher fasting glycemia both in the first trimester and with the OGTT. It should also be noted that the diagnosis of GDM according to the previous PTG criteria often included a two-stage scheme, which could delay the diagnosis. Siegel AM *et al.* (Siegel *et al.* 2016) have been evaluating the influence of the time of two-stage scheme diagnosis for gestational diabetes in 565 pregnant women who were divided into three groups; the times between the screening test and diagnostic test were <7 days, 8–14 days, >14 days, respectively. The authors found no difference among groups in terms of the perinatal outcomes in mothers and newborns (caesarean section, White class A2GDM, pre-eclampsia, macrosomia, preterm delivery, hypoglycemia and perinatal injuries), which is consistent with the results of our study.

The highest percentage of women requiring the administration of insulin was in the group that was diagnosed only with the new criteria (33.3% vs. 11.5% in the group diagnosed with only with previous PTG criteria and 24.7% in the group fulfilling both criteria). Lebriz Hale Aktun *et al.* (Aktun *et al.* 2015) found that in the diagnostic test, which was performed during pregnancy, an increase in the fasting glycemia of 1 mg/dl increases the risk of insulin administration needed for proper glucose alignment by 1.062-fold. The authors also observed the influence of the BMI before pregnancy on the need for insulin administration during pregnancy (Aktun *et al.* 2015). Furthermore, one has to remember that changes in the criteria for diagnosing GDM include criteria of proper glycemia alignment. Reducing the threshold of proper glycemia one hour after a meal from 140 mg/dL to 120 mg/dL also impacted the percentage of women requiring insulin therapy.

In our study, we observed significantly higher birth weight and higher ultrasound estimated fetal weight in newborns of women with GDM who were only diag-

nosed according to the current criteria. A similar relationship was found in the study by Ethridge JK Jr. *et al.* (Ethridge *et al.* 2014).

Meek CL *et al.* (Meek *et al.* 2015) and Ahmed S *et al.* (Ahmed *et al.* 2012) found a positive correlation between the mothers' BMI before pregnancy and the risk of macrosomia and LGA in newborns, which is consistent with studies performed by other authors, confirming the influence of pre-pregnancy BMI in women with gestational diabetes on the birth weight (Leng *et al.* 2015; Berntrop *et al.* 2015). In our study, we did not observe any differences in the frequency of macrosomia and LGA occurrence in each group, which can be explained by early diagnosis of gestational diabetes and by implementation of an intensive program diabetes therapy. In addition, it confirms the lack of serious perinatal injuries for both mothers and newborns.

Among newborns in the mothers from the group that was diagnosed only with previous PTG criteria, birth defects were observed more often than in newborns from the group fulfilling both criteria, and this result was statistically significant. However, our Department is a highly specialized reference center in fetal defects, so the population of our patients in terms of birth defects is unrepresentative.

The criteria for diagnosing GDM in accordance with the IADPSG seem to be widely adopted, but 90.6% of the members in the Society for Maternal-Fetal Medicine (SMFM) in the USA continue to recommend a two-stage scheme for diabetes diagnosis (Bimson *et al.* 2016) The majority (83.0%) apply the Carpenter-Coustan criteria for a 3-hour oral test with 100 g of glucose.

The advantage of our study is the division of the patients' population in terms of criteria for diabetes diagnosis and comparison the groups of women, who, according to the new criteria, unnecessarily underwent an intervention with those, who under the previous PTG criteria, would not undergo an intervention (diet or insulin therapy). The weak point of our study may be the small number of women fulfilling only current criteria, which is because of the recent introduction of current criteria in the Polish population. Limitation of our study was also lack of possibility to identify women who would be diagnosed and treated with GDM according to the current PTG criteria but were not with the previous PTG criteria. Moreover the analysis cannot address the impact of raising the 2-hour threshold from 140 to 153 since all women with 2-hour value above 140 were diagnosed with GDM. What is important, our study does not assess prevalence of GDM in the Polish population.

CONCLUSION

To summarize the results of our study, it should be emphasized that the new criteria for diagnosing GDM according to the IADPSG allow for identification of women who often require medical intervention in the form of insulin therapy to achieve proper glycemic control. Therefore, in accordance with the recommendations of world societies, these criteria should be widely used.

Declaration of Interest: *The authors have no potential conflicts of interest to disclose.*

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