Influence of new criteria for the diagnosis of gestational diabetes mellitus on its expected frequency of occurrence and complications

© GinPolMedProject 4 (38) 2015

Review article

LUIZA OLESZCZUK-MODZELEWSKA, KRZYSZTOF CZAJKOWSKI

Szpital Kliniczny im. ks. Anny Mazowieckiej,
II Katedra i Klinika Położnictwa i Ginekologii, Warszawski Uniwersytet Medyczny
Kierownik Kliniki: prof. dr hab. n. med. Krzysztof Czajkowski

Address for correspondence:
Luiza Oleszczuk-Modzelewska
Szpital Kliniczny im. ks. Anny Mazowieckiej,
II Katedra i Klinika Położnictwa i Ginekologii WUM,
ul. Karowa 2, 00-315 Warszawa
Tel.:+48 691 763 300, fax: +48 22 5966-487, e-mail: oleszczuk.luiza@gmail.com

Statistic

Word count	2111
Tables	1
Figures	0
References	40

Received: 15.07.2015
Accepted: 28.09.2015
Published: 21.12.2015

Summary

Gestational diabetes mellitus (GDM) is the most common glucose tolerance disorder diagnosed during pregnancy. It is associated with complications for the mother, fetus and the child in the future. A prospective multicenter study, called HAPO, demonstrated a linear relationship between glycemia in OGTT in pregnant patients and macrosomia, the frequency of cesarean sections, the level of c-peptide in the umbilical blood and neonatal hypoglycemia. Based on its results, the International Association of Diabetes and Pregnancy Study Group (IADPSG) and the World Health Organization (WHO) have proposed new criteria for GDM diagnosis. The Polish Gynecologic Society (*Polskie Towarzystwo Ginekologiczne*, PTG) accepted them in 2014.

According to the previous criteria, a fasting glucose level ranged from 95 to 126 mg/dl and increased to 140 mg/dl after 2 hours (ADA criteria from 2004, WHO from 1999 and PTG from 2011) [1–3]. Due to lower fasting glucose limit values in a OGTT test (to 92 mg/dl) and increased level after 2 hours (up to 153 mg/dl), a question arises concerning the influence of these new criteria on the frequency of GDM and complications during pregnancy and in the fetus (4–6).

A considerable number of studies conducted so far indicate an increase in diagnoses of gestational diabetes mellitus compared with the previous criteria. It is also suggested that the number of labor inductions and cesarean sections has also increased. It is estimated that the treatment of mild hyperglycemia would reduce the percentage of macrosomia, shoulder dystocia and the need for hospitalization of newborns at neonatal intensive care units [7]. It is still postulated that the new criteria should be verified in large, prospective randomized trials.

Key words: gestational diabetes mellitus; GDM diagnostic criteria; obstetric outcomes; diabetes complications

INTRODUCTION

Gestational diabetes mellitus (GDM) is defined as impaired glucose tolerance with onset or first recognition during pregnancy. It is estimated that it accounts for over 90% of all cases of impaired carbohydrate tolerance that complicate pregnancy [5,8,9]. The remaining conditions are type 1 and 2 diabetes as well as impaired glucose tolerance which were not detected before pregnancy. GDM-associated complications include an increased risk of: pre-eclampsia, pregnancy-induced hypertension (PIH), macrosomia, perinatal trauma, hyperinsulinemia, hypoglycemia, hyperbilirubinemia and carbohydrate metabolism disorders in the mother as well as future obesity in the child [10,11].

O'Sullivan and Mahan were the first to propose diagnostic criteria for gestational diabetes mellitus in 1964 [12]. Since then, the methods for diagnosing carbohydrate metabolic disorders during pregnancy

have been debated. The discussion has involved the use of screening tests, doses of glucose in glucose tolerance testing and the limits of cut-off values. The results of the HAPO study, published in 2008, set the grounds for the introduction of new criteria proposed, among others, by IADPSG in 2010, WHO in 2013 and PTG in 2014 (Tab.1) [5–7].

The aim of this article is to evaluate the consequences of the introduction of the new criteria for gestational diabetes mellitus in terms of its frequency of occurrence and complications during pregnancy and in the neonatal period.

PREDICTED CONSEQUENCES OF THE INTRODUCTION OF NEW GDM DIAGNOSTIC CRITERIA

Frequency of gestational diabetes mellitus

In the HAPO trial, gestational diabetes mellitus was diagnosed in about 17.8% of 23,957 patients treated in 15 centers in 9 countries [13]. The percentage of diagnosed GDM cases varied depending on the center and ranged from 9.3% to 25.5%. In OGTT, the following types of increased glycemia prevailed: fasting glucose in 55% of patients, after 1 hour in 33% of women and after 2 hours in 12% of patients. It is estimated that following the introduction of the IADPSG criteria, the percentage of patients with GDM in the United States may even triple [14,15].

Nwose et al. [16] analyzed women who had undergone OGTT in 1999–2008. They compared the frequency of diagnosing gestational diabetes mellitus based on the previous and new criteria. The authors concluded that the introduction of the IADPSG criteria in 2010 will result in an increase in the number of diagnosed gestational diabetes mellitus by 12% over 10 years. Mayo et al. [17] analyzed how the new IADPSG criteria affected the percentage of GDM diagnoses in patients who had OGTT interpreted according to the recommendations of the Canadian Diabetes Association (CDA) from 2008. The percentage of diagnosed GDM increased from 3.2% to 10.3%. Moreover, Kalter-Leibovici et al. [18] studied data of 3,345 patients from Israel who participated in the HAPO trial. The number of patients who met the GDM criteria proposed by IADPSG was 50% greater than the one estimated so far (9% vs 6%). Furthermore, Bodmer-Roy et al. [19] conducted a retrospective study and analyzed OGTT results in pregnant patients from 2008–2010 assessed according to the CDA 2008 criteria. The introduction of the new IADPSG criteria nearly doubled the percentage of diagnosed GDM (from 14.18% to 27.51%).

Agarwal et al. [15] assessed the results of OGTT in 10,283 patients who reported for routine examinations during pregnancy in 2003–2008. They compared the number of GDM diagnoses based on the then criteria of the American Diabetes Association (ADA) are the IADPSG criteria from 2010. The percentage of newly diagnosed GDM nearly tripled: from 12.9% to 37.7%. Leng et al. [20] conducted a prospective study in 2010–2012 in which they assessed the frequency of gestational diabetes mellitus in China (Tianjin). OGTT results were analyzed according to the WHO criteria from 1999 and compared with the IADPSG criteria from 2010. The authors noted an increase in the percentage of diagnosed GDM from 8.3% (WHO) to 9.1% (IADPSG). The change in the percentage of diagnosed GDM is not only caused by the new criteria. For instance, Yew et al. [21] conducted OGTT in 855 pregnant patients and interpreted the results in accordance with the WHO 1999 criteria and recommendations from 2013. The percentage of diagnosed GDM was found to decrease from 28.8% to 21.1%. Depending on the investigated population, the introduction of the new IADPSG criteria can result in a double or even triple increase in the number of patients with a GDM diagnosis.

Complications during pregnancy

The primary aim of the HAPO study was to assess the influence of abnormal glucose values (lower than those recommended so far) on complications during pregnancy and in the neonate [22]. Abnormal glucose levels in mothers indicated a strong relationship with the occurrence of pre-eclampsia (fasting glucose OR 1.21, 95% CI; after 1 h OR 1.28, 95% CI, after 2 h OR 1.28, 95% CI) [7]. A statistically significant relationship was also found between abnormal glucose levels after 1 and 2 h and preterm labor (fasting glucose OR 1.05, 95% CI; after 1 h OR 1.18, 95% CI, after 2 h OR 1.16, 95% CI). Moreover, a relationship was observed between increased glucose levels and the need for a cesarean section (fasting glucose OR 1.11, 95% CI; after 1 h OR 1.10, 95% CI, after 2 h OR 1.08, 95% CI).

The literature suggests that an increase in new GDM diagnoses will increase the number of cesarean sections and complications associated with this procedure. It is also estimated that the number of labor inductions without evident indications will rise [14,23,24]. Mayo et al. [17] analyzed obstetric outcomes in patients who met the CDA criteria from 2008 and the IADPSG criteria from 2010, and compared them with the outcomes of patients with normal pregnancies. Pregnancy-induced hypertension and pre-eclampsia were significantly more frequent in patients who met the new IADPSG criteria compared with the controls (8.4% vs 3.0%). Cesarean sections were conducted significantly more frequently in patients who met both the IADPSG and CDA criteria (36.8% and 34% vs 26.1%). The percentage of preterm childbirths, labor inductions and duration of hospitalization was not significantly different between the patients with GDA diagnosed with the IADPSG criteria and healthy women. Such a difference, however, was observed in patients who met the CDA criteria (7.8% vs 5.0%, 20.5% vs 11.0% and 25.7% vs 20.5%, respectively). Nayak et al. [25] also studied pregnant patients in whom OGTT was assessed based

Tab. 1. Recommendations concerning the criteria of gestational diabetes mellitus [32–40]

Recommendations	Year of introduction	Method of glucose tolerance assessment	Method of glucose tolerance assessment
O'Sullivan and Mahan [32]	1964	100 g OGTT	At least **two criteria** met: fasting glucose >=90 mg/dl (5.0 mmol/l) after 1 h >=165 mg/dl (9.2 mmol/l) after 2 h >=143 mg/dl (8.1 mmol/l) after 3 h >=127 mg/dl (6.9 mmol/l)
Carpenter-Coustan [32]	1982	100 g OGTT	At least **two criteria** met: fasting glucose >=95 mg/dl (5.2 mmol/l) after 1 h >=180 mg/dl (10.0 mmol/l) after 2 h >=155 mg/dl (8.6 mmol/l) after 3 h >=140 mg/dl (7.8 mmol/l)
WHO [33]	2006	75 g OGTT	At least **one criterion** met: fasting glucose >=126 mg/dl (7.0 mmol/l) after 2 h >=200 mg/dl (11.1 mmol/l)
WHO [6]	2013	75 g OGTT	At least **one criterion** met: fasting glucose >=92–125 mg/dl (5.1–6.9 mmol/l) after 1 h >=180 mg/dl (10.0 mmol/l) after 2 h >=153–199 mg/dl (8.5–11.0 mmol/l)
PTG [34]	2005	50 g GCT >=140-199 mg/dl (7,8-11,06 mmol/l) 75 g OGTT	GCT >=200 mg/dl (11.1 mmol/l) At least **one criterion** met in OGTT: fasting glucose >=100 mg/dl (5.5 mmol/l) after 1 h >=180 mg/dl (10 mmol/l) after 2 h >=140 mg/dl (7.8 mmol/l)
PTG [3]	2011	75 g OGTT	At least **one criterion** met: fasting glucose >=100 mg/dl (5.5 mmol/l) after 1 h >=180 mg/dl (10.0 mmol/l) after 2 h >=140 mg/dl (7.8 mmol/l)
PTG [5]	2014	75 g OGTT	At least **one criterion** met: fasting glucose >=92 mg/dl (5.1 mmol/l) after 1 h >=180 mg/dl (10.0 mmol/l) after 2 h >=153 mg/dl (8.5 mmol/l)
PTD [35]	2013	75 g OGTT	At least **one criterion** met: fasting glucose >=100 mg/dl (5.5 mmol/l) after 2 h >=140 mg/dl (7.8 mmol/l)
PTD [36]	2014	75 g OGTT	At least **one criterion** met: fasting glucose >=92–125 mg/dl (5.1–6.9 mmol/l) after 1 h >=180 mg/dl (10.0 mmol/l) after 2 h >=153–199 mg/dl (8.5–11.0 mmol/l)
CDA [37]	2008	50 g GCT >=140-184 mg/dl (7,8-10,2 mmol/l) 75 g OGTT	GCT >=185 mg/dl (10.3 mmol/l) At least **two criteria** met in OGTT: fasting glucose >=95 mg/dl (5.3 mmol/l) after 1 h >=191 mg/dl (10.6 mmol/l) after 2 h >=160 mg/dl (8.9 mmol/l)
CDA [38]	2013	50 g GCT >=140 mg/dl (7,8 mmol/l) 75 g OGTT	GCT >=200 mg/dl (11.1 mmol/l) At least **one criterion** met in OGTT: fasting glucose >=95 mg/dl (5.3 mmol/l) after 1 h >=191 mg/dl (10.6 mmol/l) after 2 h >=162 mg/dl (9.0 mmol/l)
ADA [39]	2004	50 g GCT >=130-140 mg/dl (7,2-7,8 mmol/l) 100g OGTT 75g OGTT*	At least **two criteria** met in OGTT: fasting glucose >=95 mg/dl (5.3 mmol/l) after 1 h >=180 mg/dl (10.0 mmol/l) after 2 h >=155 mg/dl (10.6 mmol/l) after 3 h >=140 mg/dl (7.8 mmol/l) – in the case of 100 g OGTT

Tab. 1. Cont.

Recommendations	Year of introduction	Method of glucose tolerance assessment	Method of glucose tolerance assessment
ADA [40]	2013	75 g OGTT	At least **one criterion** met: fasting glucose >=92 mg/dl (5.1 mmol/l) after 1 h >=180 mg/dl (10 mmol/l) after 2 h >=153 mg/dl (8.5 mmol/l)
IADPSG [4]	2010	75 g OGTT	At least **one criterion** met: fasting glucose >=92 mg/dl (5.1 mmol/l) after 1 h >=180 mg/dl (10.0 mmol/l) after 2 h >=153 mg/dl (8.5 mmol/l)

* alternatively

GDM *(Gestational Diabetes Mellitus)*; GCT (*Glucose Challenge Test)*; OGTT *(Oral Glucose Tolerance Test);* WHO *(World Health Organization*); PTG *(Polish Gynecologic Society [Polskie Towarzystwo Ginekologiczne]);* PTD *(Polish Diabetes Association [Polskie Towarzystwo Diabetologiczne]);* CDA (*Canadian Diabetes Association*); ADA *(American Diabetes Association)*; IADPSG (*International Association of Diabetes and Pregnancy Study Groups*)

on the IADPSG criteria. They found that polyhydramnios was significantly more common in patients with GDM (6.0% vs 0.5%). Generally, PIH, PROM and preterm delivery were more common in patients with gestational diabetes mellitus. The number of labor inductions and cesarean sections was not different between the groups. The gestational age at the conclusion of pregnancy was significantly higher in healthy patients (38.83±1.23 vs 38.45±1.36, p=0.02). The study of Bodmer-Roy et al. [19] did not show statistical significance with respect to the percentage of pre-eclampsia and cesarean sections between patients who met the criteria of IADPSG and healthy women.

Complications in newborns

In studies on the influence of gestational diabetes mellitus on the course of the neonatal period, the following parameters are assessed: birth weight, hypertrophy and complications such as: hypoglycemia, hyperinsulinemia, hyperbilirubinemia, the need for hospitalization and duration of hospitalization at intensive care units.

The HAPO study conducted among women with diabetes revealed a strong relationship between glucose levels measured in OGTT and birth weight (fasting glucose OR 1.38, 95% CI, after 1 h OR 1.46, 95% CI, after 2 h OR 1.38, 95% CI) as well as C-peptide level in the umbilical blood >90th percentile (fasting glucose OR 1.55, 95% CI, after 1 h OR 1.46, 95% CI, after 2 h OR 1.37, 95% CI) [7]. A positive relationship was observed between increasing glycemia and: shoulder dystocia, perinatal trauma, hyperbilirubinemia, hypoglycemia and the need for hospitalization at the neonatal intensive care unit (NICU).

A retrospective study from Toronto compared the outcomes in patients with OGTT interpreted on the basis of the CDA criteria from 2008 and the IADPSG criteria. The group that met the CDA criteria presented a higher rate of newborn hospitalization at the NICU (7.3% vs 4.1%), hyperbilirubinemia (9.4% vs 6.4%) and hypoglycemia (7.3% vs 1.1%) compared with healthy pregnant patients [17]. Hypertrophy and birth weight >90th percentile were more often observed in the group of patients with diabetes mellitus diagnosed on the basis of both CDA and IADPSG criteria (7.8% and 12.3% vs 9.3% 11.7% and 13.5% vs 8.1%). There were no significant differences between the groups in terms of: the occurrence of shoulder dystocia, perinatal trauma or respiratory distress syndrome. Nayak et al. [25] found a significant difference in the percentage of neonates hospitalized at NICUs (>24 hours) born of patients with GDA assessed according to the IADPSG criteria compared with healthy patients (10.8% vs 4.1%). The average birth weight and the percentage of hypertrophy did not differ between the groups. Furthermore, there were no significant differences concerning the percentage of respiratory distress syndrome, hyperbilirubinemia and perinatal mortality.

Bodmer-Roy et al. [19] did not find any significant differences concerning the number of newborns with body weight >90th percentile between the group of mothers who met the IADPSG criteria and healthy women (9.1% vs 5.9%, p=0.19). Respiratory distress syndrome was more common in newborns of mothers with GDM (8.6% vs 3.8%, p=0.06). When the manner of delivery (natural vs cesarean section) was included, the differences were not statistically significant. Moreover, no statistically significant differences were observed in terms of the percentage of hypoglycemia (2.2% vs 4.3%, p=0.24), hyperbilirubinemia (2.2% vs 5.6%, p=0.08) and duration of hospitalization >24 hours at the NICU (6.5% vs 5.4%, p=0.7).

With the previous GDM diagnostic criteria, GDM-associated complications included: increased risk of future type 2 diabetes, arterial hypertension and obe-

sity in the child [6,26]. Currently, there is no evidence concerning the type and rate of these complications with respect to the new criteria. In 2010, Gillman et al. [27] assessed the influence of treating mild forms of hyperglycemia during pregnancy on BMI of children aged 4–5 years. The values >=85th percentile were noted in 33% of children born of mothers who were treated for gestational diabetes mellitus and in 27.6% of children of untreated mothers (macrosomia diagnosed in 5.3% vs 21.9% of newborns, respectively).

Despite the positive influence of treating benign hyperglycemic state on lowering the rate of macrosomia, such a therapy was not found beneficial when BMI in children at the age of 4–5 was assessed. Pirkola et al. [28] studied the influence of obesity and gestational diabetes mellitus in the pregnant on BMI of their children at the age of 16. The highest risk of overweight and abdominal obesity was noted in children of patients with BMI >=25 kg/m˛ and GDM (overweight OR 4.05, abdominal obesity OR 3.82). In the case of mothers with normal pre-pregnancy body weight and GDM, there was no risk of obesity in their children (OR 0.73 and OR 1.22). Pre-pregnancy overweight is an independent risk factor of both complications (OR 2.56 i OR 2.6).

Furthermore, Hung Tam et al. [29] noted in 2010 that children of mothers with diagnosed gestational diabetes mellitus carry a higher risk of metabolic syndrome and overweight in adolescence (control at the age of 15) compared with children of healthy women (7.1% vs 3.4%, p=0.35). There were no relationships between birth weight and BMI at the age of 15.

CONCLUSION

Despite being accepted by renowned Diabetes Associations, the new diagnostic criteria for gestational diabetes mellitus still cause controversy. Their introduction is justified by: the reference of the cut-off points to complications typical of gestational diabetes mellitus (such as macrosomia, C-peptide level >90 percentile), randomized studies indicating that the treatment of mild hyperglycemia during pregnancy has an impact on lowering the number of GDM complications, financial advantage resulting from the protection of mothers and children from the complications of gestational diabetes mellitus in the future and easier GDM treatment [24,30,31].

Arguments against the introduction of the new criteria include: a considerable increase in the number of patients diagnosed with gestational diabetes mellitus, limited repeatability of oral glucose tolerance test (up to 30% of negative diagnoses in patients previously classified as having GDM), overload of the health care system with the need of engaging interdisciplinary teams in the therapeutic process (gynecologists, dietitians, endocrinologists), stigmatizing patients (higher-risk pregnancy) and increased percentage of obstetric interventions (labor induction, cesarean sections) [14,24,30].

In order to verify the actual influence of the new criteria, it is necessary to collect data on complications during pregnancy and in children as well as the percentage of women who need insulin treatment. It also needs to be verified whether increasing the cut-off point for glycemia two hours after glucose intake can influence the number of diagnosed cases of macrosomia and shoulder dystocia in children of patients classified as healthy.

References:

1. **American Diabetes Association**. Gestational Diabetes Mellitus. *Diabetes Care* 2004;27(1):S88-90.
2. **World Health Organization.** Definition, Diagnosis and Classification of Diabetes Mellitus and its Complications. Report of a WHO Consultation. Part 1:Diagnosis and Classification of Diabetes Mellitus. *WHO* 1999;19-52.
3. **Polskie Towarzystwo Ginekologiczne**. Standardy Polskiego Towarzystwa Ginekologicznego postępowania u kobiet z cukrzycą. *Ginekol Pol* 2011;82:474-79.
4. **International Association of Diabetes and Pregnancy Study Groups Consensus Panel**. International Association of Diabetes and Pregnancy Study Groups Recommendations on the Diagnosis and Classification of Hyperglycemia in Pregnancy. *Diabetes Care* 2010; 33(3):676-82.
5. **Polskie Towarzystwo Ginekologiczne.** Standardy Polskiego Towarzystwa Ginekologicznego postępowania u kobiet z cukrzycą-aktualizacja. *Ginekol Pol* 2014; 85:476-78.
6. **World Health Organization**. Diagnostic Criteria and Classification of Hyperglycaemia First Detected in Pregnancy. *WHO* 2013;1-62.
7. **Lowe LP, Metzger BE, Dyer AR et al.** The Hyperglycemia and Adverse Pregnancy Outcome (HAPO) Study: An Overview. In: Kim C, Ferrara A (Ed.): Gestational Diabetes During and After Pregnancy. London: Springer-Verlag; 2010;17-34.
8. **Łagoda K, Kobus G, Bachórzewska-Gajewska H.** Wpływ cukrzycy ciążowej na rozwój płodu i noworodka. *Endokrynologia, otyłość i zaburzenia przemiany materii* 2008;4(4):168-73.

9. **Wójcikowski C.** Rozwój zaburzeń tolerancji węglowodanów po ciąży powikłanej cukrzycą ciążową. *Diabetologia Praktyczna* 2004;5(2):113-16.
10. **Helseth R, Salvesen O, Stafne SN et al.** Gestational diabetes mellitus among Nordic Caucasian women: Prevalence and risk factors according to WHO and simplified IADPSG criteria. *Scandinavian Journal of Clinical & Laboratory Investigation* 2014; 74:620–28.
11. **Ashwal E, Hod M.** Gestational diabetes mellitus: Where are we now? *Clin Chim Acta* 2015 [In press].
12. **Knopp RH. John B. O'Sullivan**. A Pioneer in the study of Gestational Diabetes. *Diabetes Care* 2002; 25(5):943-44.
13. **Sacks DA, Hadden DR, Maresh M et al.** Frequency of Gestational Diabetes Mellitus at Collaborating Centers Based on IADPSG Consensus Panel-Recommended Criteria. The Hyperglycemia and Adverse Pregnancy Outcome (HAPO) Study. *Diabetes Care* 2012; 35(3):526–28.
14. **Reece EA, Moore T.** The diagnostic criteria for gestational diabetes: to change or not to change? *Am J Obstet Gynecol* 2013;208(4):255-59.
15. **Agarwal MM, Dhatt GS, Shah SM.** Gestational Diabetes Mellitus. Simplifying the International Association of Diabetes and Pregnancy diagnostic algorithm using fasting plasma glucose. *Diabetes Care* 2010;33(9):2018–20.
16. **Nwose EU, Richards RS, Bwititi PT et al.** New Guidelines for Diagnosis of Gestational Diabetes: Pathology-Based Impact Assessment. *N Am J Med Sci* 2013; *5*(3):191–94.
17. **Mayo K, Melamed N, Vandenberghe H et al.** The impact of adoption of the International Association of Diabetes in Pregnancy Study Group criteria for the screening and diagnosis of gestational diabetes. *Am J Obstet Gynecol* 2015;212:224.e1-9.
18. **Kalter-Leibovici O, Freedman LS, Olmer L et al.** Screening and Diagnosis of Gestational Diabetes Mellitus. Critical appraisal of the new International Association of Diabetes in Pregnancy Study Group recommendations on a national level. *Diabetes Care* 2012; 35:1894–96.
19. **Bodmer-Roy S, Morin L, Cousineau J et al.** Pregnancy outcomes in women with and without diabetes mellitus according to the International Association of the Diabetes and Pregnancy Study Groups criteria. *Obstet Gynecol* 2012; 120: 746-52.
20. **Leng J, Shao P, Zhang C et al.** Prevalance of Gestational Diabetes Mellitus and Its Risk Factors in Chinese Pregnant Women: A Prospective Population-Based Study in Tianjin, China. PLoS ONE [periodyk online] 2015 March [cytowany 2015.06.12]; 10(3): e0121029: [12 ekranów]. Dostępny pod adresem URL: http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0121029.
21. **Yew TW, Khoo CM, Thai AC et al.** The Prevalence of Gestational Diabetes Mellitus Among Asian Females is Lower Using the New 2013 World Health Organization Diagnostic Criteria. *Endocr Pract* 2014;20:1064-69.
22. **HAPO study Cooperative Research Group.** The Hyperglycemia and Adverse Pregnancy Outcome Study (HAPO). *International Journal of Gynecology and Obstetrics* 2002;78(1):69-77.
23. **Blanchette H.** The rising cesarean delivery rate in America: what are the consequences? *Obstet Gynecol* 2011;118(3):687-90.
24. **Visser GHA, Valk HW.** Is the evidence strong enough to change the diagnostic criteria for gestational diabetes now? *Am J Obstet Gynecol* 2013;208(4):260-64.
25. **Nayak PK, Mitra S, Sahoo JP**. Feto-maternal outcomes in women with and without gestational diabetes mellitus according to the International Association of Diabetes and Pregnancy Study Groups (IADPSG) diagnostic criteria. *Diabetes & Metabolic Syndrome: Clinical Research & Reviews* 2013;7:206–09.
26. **Simeoni U, Barker DJ.** Offspring of diabetic pregnancy: Long-term outcomes. *Seminars in Fetal & Neonatal Medicine* 2009;14:119-24.
27. **Gillman MW, Oakey H, Baghurst PA et al.** Effect of treatment of gestational diabetes mellitus on obesity in the next generation. *Diabetes Care* 2010;33(5):964-68.
28. **Pirkola J, Pouta A, Bloigu A et al.** Risks of Overweight and Abdominal Obesity at Age 16 Years Associated with Prenatal Exposures to Maternal Pregnancy Overweight and Gestational Diabetes Mellitus. *Diabetes Care* 2010;33:1115-121.
29. **Tam WH, Ma WRC, Yang X et al.** Glucose Intolerance and Cardiometabolic Risk in Adolescents Exposed to Maternal Gestational Diabetes. *Diabetes Care* 2010;33(6):1382-84.
30. **Blackwell SC, Rouse DJ.** Gestational diabetes-staying with old or marrying new guidelines. *Am J Obstet Gynecol* 2011;204(5):371-72.
31. **Ohno MS, Sparks TN, Cheng YW et al.** Treating mild gestational diabetes mellitus: a cost-effectiveness analysis. *Am J Obstet Gynecol* 2011;205(3):282.e1-82.e7.
32. **Haute Autorite de Sante. Guidelines Department**. Screening and diagnosis of gestational diabetes mellitus. Summary report 2005;1-10.
33. **World Health Organization.** Definition and diagnosis of gestational diabetes mellitus and intermediate hyperglycemia-report of a WHO/IDF consultation. *WHO* 2006;1-46.
34. **Polskie Towarzystwo Ginekologiczne.** Standardy Polskiego Towarzystwa Ginekologicznego postępowania u kobiet z cukrzycą. *Ginekol Pol* 2005;76:68-76.
35. **Stanowisko Polskiego Towarzystwa Diabetologicznego**. Cukrzyca a ciąża. W: Zalecenia kliniczne dotyczące postępowania u chorych na cukrzycę 2013. *Diabetologia Kliniczna* 2013;2:A45-7.
36. **Stanowisko Polskiego Towarzystwa Diabetologicznego**. Cukrzyca a ciąża. W: Zalecenia kliniczne dotyczące postępowania u chorych na cukrzycę 2014. *Diabetologia Kliniczna* 2014;3:A46-9.
37. **Thompson D, Capes S, Feig D et al.** Diabetes and Pregnancy. Canadian Diabetes Association Clinical Practice Guidelines Expert Commitee. *Can J Diabetes* 2008; 32(1):S168-80.
38. **Thompson D, Berger H, Feig D et al.** Diabetes and Pregnancy. Canadian Diabetes Association Clinical Practice Guidelines Expert Commitee. *Can J Diabetes* 2013; 37:S168-83.
39. **American Diabetes Association.** Gestational Diabetes Mellitus. *Diabetes Care* 2004; 27(1): S88-90.
40. **American Diabetes Association.** Standards of Medical Care in Diabetes-2013. *Diabetes Care* 2013;36(1):S11-66.