Occurrence of gestational diabetes mellitus: 
prognostic value of diabetes risk factors

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Abstract

Objectives: The aim of the study was to evaluate the prevalence of gestational diabetes mellitus (GDM) and the presence of risk factors for GDM and their predictive value. Material and methods: In prospective observational cohort study we analysed 1579 pregnant women living mainly in defined geographic area Czechów in Lublin, who were attending prenatal care in time period: 1999-2008. The screening test for gestational diabetes mellitus was based on two-step approach according to recommendations of the Polish Diabetes Association. Women underwent 1 h 50 g glucose challenge test between 24 and 28 weeks pregnancy. If the plasma glucose value at 1 h was ≥ 7.8 mmol/l, a patient was asked to undergo a 2-h 75-g oral-glucose-tolerance test after an overnight fast. GDM was diagnosed when glucose value at 2 h exceeded 7.8 mmol/l. Risk factors for diabetes were quantified for each pregnant woman: age at conception, parity, overweight/obesity, prior macrosomia, family history of diabetes, glycosuria. Results: The incidence of GDM was 4% in study population. The GDM patients were significantly older than pregnant ones without GDM (28.9 vs. 25.2, p < 0.0001), had a greater BMI before pregnancy (24.6 vs. 22.1, p < 0.0001) and there was a bigger percentage of multipara (60.3% vs. 44.1%, p = 0.0158). The rate of GDM was significantly higher in women with a positive family history of diabetes [odds ratio (OR), 4.18], age ≥ 35 years (OR, 3.10), previous pregnancies ≥ 3 (OR, 3.39), prepregnancy BMI ≥ 27 kg/m² (OR, 2.85), prior macrosomia (OR, 2.34), glycosuria (OR, 2.29). All risk factors together identified 61.4 % of pregnant women. 38.6% of study pregnant women were characterized by low risk for GDM (age < 25 years, normal weight before pregnancy, not known family history of diabetes, no history of poor obstetric outcome), and incidence of a disease was 1.3%, which determined 12.7% of total diagnosed cases of GDM. Conclusions: In study population GDM was diagnosed in 63 (4%) pregnant women, including 8 cases in women with low risk. Possibility of oversight of diagnosis of gestational diabetes in women with low risk for GDM indicates necessity of universal screening execution.

Key words: gestational diabetes mellitus, screening, prevalence, risk factors for GDM

Introduction

Gestational diabetes mellitus (GDM) is defined as “any degree of glucose intolerance with onset or first recognition during pregnancy independently whether insulin is used for treatment and whether the condition persists after pregnancy; it does not exclude the possibility that unrecognized glucose intolerance may have antedated or begun concomitantly with the pregnancy” [1-3]. GDM is characterized by pancreatic β-cell dysfunction and decrease in tissue sensitivity to insulin. Lack of ability to secrete more insulin to meet the increased demands of pregnancy and to compensate for the insulin resistance, leads to development of hyperglycemia in consequence [3, 4]. The causes of pancreatic β-cell dysfunction that lead to insulin insufficiency in GDM are not fully defined. Three general categories have been identified: 1) autoimmune destruction of pancreatic β-cells, 2) genetic abnormalities that lead to impaired insulin secretion, and 3) β-cell dysfunction that occurs on a background of chronic insulin resistance [5-8].

Existing metabolic disturbances are associated with substantial rates of maternal complications, such as pregnancy-induced hypertension, preeclampsia, polyhydramnios, urinary tract infection, premature birth, cesarean delivery and fetal/neonatal complications, such as macrosomia, shoulder dystocia, birth injuries as bone fractures and nerve palsies, hypoglycemia [9-12]. In pregnancies complicated by diabetes, it would lead to increased risk of developing type 2 diabetes in later life [8]. Offspring of women with GDM are at increased risk for childhood obesity, retarded psychomotor development and early onset of glucose intolerance and type 2 diabetes mellitus [13].

The prevalence of GDM varies from 1.2% to 13.3% of all pregnancies, depending on ethnic and racial composition of study population. Most commonly, GDM affects between 2% and 5% of pregnant women [14, 15]. In the last years trends in increased prevalence of GDM have been observed [14, 16, 17]. In the population the amount of GDM is reflective of incidence of type 2 diabetes in that population [18].
This wide variation of data concerning incidence of GDM may be due to the lack of standardization of screening tests and diagnostic criteria, and may also reflect differences in the distribution of genetic and environmental risk factors. The clinical detection of GDM is accomplished in different ways in different countries. In general, the approaches apply one of the following procedures: 1) universal screening includes all pregnant women, 2) selective screening based on risk factors for GDM [19, 20]. Controversies regarding the optimal methods for detecting GDM are beyond the scope of this article. The United States Preventive Services Task Force (USPSTF) concluded that there is not enough evidence to support or deny universal screening for GDM [21].

The aim of the study was to evaluate the prevalence of gestational diabetes mellitus and the presence of risk factors for GDM and their predictive value.

Material and methods

In prospective observational cohort study we analysed 1579 pregnant women, aged 16-45 years, 873 nullipara (55.3%), living mainly in defined geographic area Czechów in Lublin, who were attending prenatal care between the years of 1999 and 2008. Mean age of women was 25.4 ± 5.2 years, body mass index (BMI) were 22.2 ± 3.7 kg/m² (average weight: 59.6 ± 10.5 kg, and average height: 163.7 ± 5.7 cm).

In all pregnant women challenge and/or diagnostic test was performed according to Polish Diabetes Association recommendation [22]. The screening test for GDM was based on two-step approach. Women underwent 1h 50-g glucose challenge test (OCT) between 24 and 28 weeks of pregnancy. If the plasma glucose value at 1 h was \(7.8\) mmol/l (\(140\) mg/dl), a patient was asked to undergo a 2-h 75-g oral-glucose-tolerance test (OGTT) after an overnight fast. GDM was diagnosed when glucose value at 2 h exceeded \(7.8\) mmol/l (>140 mg/dl). In case of abnormal result of OCT, and normal result of OGTT, diagnostic test was carried out at 32 week gestation.

Risk factors for diabetes were quantified for each pregnant woman: age at conception, height and weight before pregnancy, prepregnancy nutritional status described as BMI, parity, prior macrosomia, family history of diabetes, glycosuria in current pregnancy (more than one event). Based on occurrence and value risk indicators following groups of pregnant women with different risk for GDM were selected: (a) high-risk group: maternal age ≥ 35 years, pregravid overweight and obesity (BMI ≥ 27 kg/m²), history of diabetes mellitus in a first-degree relative, parity ≥ 3, history of macrosomia, glycosuria; (b) low-risk group: maternal age < 25 years, weight normal before pregnancy (BMI < 25 kg/m²), not known diabetes in first-degree relatives, no history of poor obstetric outcome; (c) moderate-risk group: including women who did not meet inclusion criteria on particular groups [2, 23].

Statistical analysis. Descriptive statistics included means and standard deviations (SDs) for continuous variables and number and percentage for categorical variables. Differences between the means were assessed with use of the U-Mann-Whitney test. For the comparison of proportions the Chi² or Fisher’s test (depending on group count) were used. A \(P\) value of 0.05 was considered to indicate statistical significance. Odds ratios (OR) were determinated using the Mantel-Haenszel technique [24]. Estimates of 95% confidence intervals (95% CI) were made with a test-based method, based on the Mantel-Haenszel chi-square [25].

Results

Gestational diabetes mellitus was diagnosed in 63 (4.0%) pregnant women of the 1579 pregnant women participated in the study.

<table>
<thead>
<tr>
<th>Maternal age (years)</th>
<th>Women with GDM ((n = 63))</th>
<th>Women without GDM ((n = 1516))</th>
<th>(P)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maternal age (years)</td>
<td>28.9 (5.8)</td>
<td>25.2 (5.1)</td>
<td>&lt; 0.0001</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>162.4 (4.9)</td>
<td>163.7 (5.8)</td>
<td>0.0435</td>
</tr>
<tr>
<td>Pregravid weight (kg)</td>
<td>65.1 (14.3)</td>
<td>59.4 (10.3)</td>
<td>0.0015</td>
</tr>
<tr>
<td>Pregravid BMI (kg/m²)</td>
<td>24.6 (5.1)</td>
<td>22.1 (3.6)</td>
<td>&lt; 0.0001</td>
</tr>
<tr>
<td>Parity</td>
<td>1.1 (1.2)</td>
<td>0.7 (0.9)</td>
<td>0.0118</td>
</tr>
</tbody>
</table>

Data presented as mean (SD) or \(n\) (%);
GDM – gestational diabetes mellitus, BMI – body mass index
Table 2. The prevalence of risk factors for gestational diabetes mellitus and odds ratio for each risk factor analysed

<table>
<thead>
<tr>
<th>Risk factors</th>
<th>Women with GDM (n = 63)</th>
<th>Women without GDM (n = 1516)</th>
<th>OR (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age at conception ≥ 35 years</td>
<td>10 (15.9)</td>
<td>87 (5.7)</td>
<td>3.10 (1.52-6.30)</td>
</tr>
<tr>
<td>Overweight/obesity (BMI ≥ 27 kg/m²)</td>
<td>14 (22.2)</td>
<td>138 (9.1)</td>
<td>2.85 (1.54-5.30)</td>
</tr>
<tr>
<td>≥ 3 pregnancies</td>
<td>9 (14.3)</td>
<td>71 (4.7)</td>
<td>3.39 (1.61-7.14)</td>
</tr>
<tr>
<td>Family history of diabetes</td>
<td>8 (12.7)</td>
<td>51 (3.4)</td>
<td>4.18 (1.89-9.23)</td>
</tr>
<tr>
<td>History of macrosomia</td>
<td>7 (11.1)</td>
<td>77 (5.1)</td>
<td>2.34 (1.03-5.30)</td>
</tr>
<tr>
<td>Glycosuria in current pregnancy</td>
<td>9 (14.3)</td>
<td>103 (6.8)</td>
<td>2.29 (1.01-4.76)</td>
</tr>
</tbody>
</table>

Data presented as n (%); GDM – gestational diabetes mellitus, OR – odds ratio, CI – confidence interval, BMI – body mass index

Table 3. Incidence of gestational diabetes in groups of pregnant women with different risk for GDM

<table>
<thead>
<tr>
<th>Study groups</th>
<th>Number of groups</th>
<th>Incidence of GDM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low-risk women*</td>
<td>610</td>
<td>8 (1.3)</td>
</tr>
<tr>
<td>Moderate-risk women</td>
<td>519</td>
<td>19 (3.7)</td>
</tr>
<tr>
<td>High-risk women**</td>
<td>450</td>
<td>36 (8.0)</td>
</tr>
<tr>
<td>Overall</td>
<td>1579</td>
<td>63 (4.0)</td>
</tr>
</tbody>
</table>

Data presented as n (%); GDM – gestational diabetes mellitus; * – maternal age <25 years, normal weight before pregnancy, not known diabetes in first-degree relatives, no history of poor obstetric outcome; ** – maternal age ≥ 35 years, pregravid BMI ≥ 27 kg/m², history of diabetes mellitus in a first-degree relatives, ≥ 3 pregnancies, history of macrosomia, glycosuria

Table 1 summarizes clinical characteristics of the two groups. The GDM women were significantly older, had significantly increased mean BMI and they had high parity, than healthy pregnant ones.

Prevalence and odds ratios for GDM for each risk factor are presented in Table 2. Each analysed risk factor was found significantly more often in the women with GDM than in subjects without GDM. For assessment of relation between presence risk factors and diagnosis of GDM odds ratio and 95% confidence intervals were calculated demonstrating substantial impact each of these factors on incidence of gestational diabetes.

Depending on grade risk factor for GDM, gestational diabetes uncover in 55 (5.7% this subgroup (n = 969)) women with high and moderate risk and in 8 (1.3% this subgroup) patients with low risk, constituted the 12.7% of all gestational diabetes (Table 3).

Discussion

In study population living mainly in defined geographic area Czechów in Lublin GDM was identified in 63 (4%) pregnant women. GDM was diagnosed in universal screening according to Polish Diabetes Association and Polish Gynaecologic Society recommendation [1, 2]. This data are consistent with results of previous population-based studies that showed incidence of GDM in different regions of Poland varies from 1.9% to 3.9% [26-29]. Incidence of GDM is related to general diabetes prevalence in a given community [30].

Analysis of the risk factors showed that several clinical factors – older age, family history of diabetes, weight over 27 kg m⁻², parity, macrosomia, glycosuria – are associated with development of gestational diabetes mellitus. This same order of importance is documented in other studies [31-35]. It results from literary data, which our study confirmed, that family history of diabetes in a first-degree relative is one of the strongest risk factor for GDM (OR, 4.18) [31, 34, 36]. Excessive body mass before pregnancy also has significant influence on emerging of GDM and it was confirmed by my study and other authors’ studies [31, 37, 38]. Tarloni et al. in meta-analysis have showed that OR for GDM in overweight, moderately obese and morbidly obese women, compared with normal weight women, were 1.97 (95% CI, 1.77-2.19), 3.01 (95% CI, 2.34-3.87) and 5.55 (95% CI, 4.27-7.21) respectively. For every 1 kg/m² increase in BMI, prevalence of GDM increased by 0.92% (95% CI, 0.73-1.10) [39]. There’s compliance in the literature that advanced age of pregnant women increased risk for GDM.
In our study an age ≥ 35 years increased the risk more than threefold (OR, 3.10). Couston et al. showed that occurrence of GDM in women of age below 20 years incidence GDM was 0.5% and increased to 4.0% in pregnant women of age above 35 years [42]. Our results demonstrated that parity is also considerably connected with risk for GDM (≥ 3 pregnancies, OR = 3.39), similar to other studies [34, 35, 43]. In contrast, according to Seghieri et al. parity is not directly linked to frequency of GDM, although it is linked through the mediation of progressive ageing and weight gain either before or during pregnancy, when there is a sufficiently long time interval between pregnancies [44]. Birth of child of weight > 4000 g, as well as large fetal weight during pregnancy are regarded as significant risk factors for GDM by majority of authors [45-48]. These findings are in agreement with our results (OR, 2.34). Some authors ascribed prognostic importance to appearance of glycosuria in course of pregnancy. Presence of glucose in the urine was detected more often in women with GDM (OR, 2.29), however appeared only in about 15% of cases, and it was confirmed by other studies [49, 50]. Detection of glucose in the urine is indication to diagnostic examination, although routine screening of glycosuria at every perinatal visit proved useless at clinical practice [51, 52].

As mentioned above risk factors for GDM statistically significantly increased prevalence of gestational diabetes. In described analysis one or more of the established risk indicators were present in just over half of the pregnant women (61.4%) [among them 55 cases (5.7%) with GDM were diagnosed]. Categorizing these women into moderate/high risk group would determine basis of selective screening [23, 53-54].

Six hundred and ten (38.6%) women were considered as a low risk group for GDM (no family history of diabetes, under 25 years of age, pregravid normal weight). Among them, gestational diabetes was diagnosed in 8 (1.3%) pregnant women, which was constituted the 12.7% of all gestational diabetes. According to American Diabetes Association (ADA) recommendation this group of pregnant women is not a subject to screening examination [23]. Other authors came to similar conclusions. Moses et al. demonstrated that in low-risk pregnant women (19.7% of study population) prevalence of GDM was 2.8% (8.7% of all cases) [55]. According to Williams et al. 4% of women with GDM belong to low-risk group [56]. Jiménez-Moleón et al. also showed that women without risk constitute 40.8% of study population and among them they detect 7 (0.9%) of gestational diabetes (10.9% of whole of recognition) [57]. Yang et al. diagnosed 12.0% cases with GDM in group 2248 low-risk women [58]. Jensen et al. made similar observation and found 9.5% women with GDM in group 3337 of pregnant subjects without risk [59]. Di Cianni et al. showed women without risk factor constituted 5.6% of study population and among this population 5 cases of GDM were revealed (1.5% of all gestational diabetes) [32]. In occurrence of risk factors of GDM in study populations observational differences perhaps may result from phenotypic, demographic, nutritional, dietary and social differences in separate states.

Possibility of oversight of diagnosis of gestational diabetes in women with low risk for GDM indicates necessity of universal screening execution. Recently published results of international, multicenter HAPO (Hyperglycaemia and Adverse Pregnancy Outcome) study included 23,316 pregnant women, which underwent 75-g OGTT at 24 to 32 weeks of gestation [12]. Data remained blinded if the fasting glucose level was 105 mg/dl (5.8 mmol/l) or less and the 2-hour plasma glucose level was 200 mg/dl (11.1 mmol/l) or less. Achieved data unambiguously show that together with an increase of glucose level risk of primary cesarean delivery, makrosomia, neonatal hypoglycemia and cord-blood serum C-peptide increases. Significant associations were also observed for secondary outcomes (premature delivery, shoulder dystocia or birth injury, intensive neonatal care, hyperbilirubinemia, preeclampsia), although these tended to be weaker. These data did not confirm previous speculations that impaired glucose tolerance (glycemia between 7.8-11.0 mmol/l in 2-hour) had only limited unfavorable influence on pregnancy outcome [12]. Also results of ACHOIS (Australian Carbohydrate Intolerance Study in Pregnant Women) study indicate that treatment of women with impaired glucose tolerance reduces the rate of serious perinatal complications, without increasing the rate of cesarean delivery [11].

In conclusion, in study population gestational diabetes mellitus was diagnosed in 63 (4%) pregnant women. GDM appeared significantly more often among women with risk factors for gestational diabetes, although 8 cases (12.7% of all gestational diabetes) were diagnosed in women without risk factors. Possibility of oversight of diagnosis of gestational diabetes in women with low risk for GDM indicates necessity for universal screening execution.

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References


