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ORIGINAL ARTICLE

The effectiveness of selected temporary testing protocols for gestational diabetes during the COVID-19 pandemic

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Abstract

Objective During the COVID-19 pandemic, the screening approach to the diagnosis of gestational diabetes mellitus (GDM) was subject to emergency simplifications. We aimed at assessing the effectiveness of two of these temporary pandemic protocols—namely the Australian and UK, and to examine the insights they gave into the effectiveness of the more standard WHO-outlined GDM diagnosis protocol.

Methods We performed a retrospective analysis of 432 GDM patients attending the outpatient clinic at the University Hospital of Cracow, Poland throughout 2020.

Results When applying the UK criteria, 272 (63.0%) of 432 GDM cases would be missed. Women with missed-GDM by UK criteria were slightly older, had lower BMI, and had lower use of insulin. The frequency of child perinatal complications was lower in the missed GDM group (7.6% vs. 18.9%, $p=0.042$) when compared to the non-missed cases group. When applying the Australian criteria, 86 of 432 (19.9%) GDM cases would be missed. Women with missed-GDM by the Australian criteria had lower BMI and less commonly used insulin than the women not missed. There were no differences in the frequency of child and maternal complications.

Conclusions Modifications proposed from the UK and Australia resulted in varying decreases and delays in GDM diagnoses, but with no apparent harm to mothers and offspring. More studies are required to investigate the impact of the simplification of GDM diagnosis on pregnancy outcomes.

Keywords Gestational diabetes mellitus · GDM · COVID-19 · SARS-Cov-2 · Screening

Key findings and clinical implications

- More liberal gestational diabetes screening protocols used during COVID-19 resulted in varying decreases and delays in GDM diagnoses.
- However, an increased risk of pregnancy complications was not observed among the women undiagnosed ('missed') when screening with the temporary criteria.
- More liberal criteria may be of probable benefit due to less potential exposure to COVID-19 or any similar future large-scale health crises due to an outbreak of infectious disease.
- This study, among many, suggests that the regular, commonly used WHO protocol can lead to GDM overdiagnosis.

Introduction

The oral glucose tolerance test (OGTT) is the "gold standard" in the diagnosis of gestational diabetes mellitus (GDM) [1], despite multiple variations in criteria and diagnostic methods between countries [2]. In Poland, as well as numerous other countries, the World Health Organization (WHO) criteria for GDM diagnosis has been in use since 2014 [3]. This protocol choice was based on the results of the HAPO (Hyperglycemia and Adverse Pregnancy Outcome)

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study [4], which found that the current WHO protocol produced fewer adverse perinatal outcomes. However, selected national associations recommend utilization of other diagnostic approaches and cut-off values. In some countries, screening is limited only to women at high risk of GDM, though in others it is universal. Moreover, the diagnostic criteria of GDM throughout the last 30 years were subject to change several times, making the prevalence of testing varied by region and the modernity of the governing system [5]. Amid the many varied methods of testing, there is a long dispute regarding which approach assures a proper balance between women's safety and overdiagnosis [5–8]- as this balance is a major goal of diabetes detection.

The current WHO approach was again contested by some during the coronavirus disease 2019 (COVID-19) pandemic. Several organizations proposed new, temporary criteria for GDM diagnosis to shorten the original multi-step diagnostic process [9–11] and thereby decrease the risk of COVID-19 infection in pregnant women. "Diabetes Poland" decided against changing the GDM screening algorithm during the pandemic, resulting in the utilization of traditional criteria for GDM testing [3]. Initially, the protocol changes taken by other countries were ad hoc to decrease the exposure of pregnant women to SARS-Cov-2. However, they eventually added to the discussion about whether the original approach is suitable for GDM diagnosis and provided valuable tools for comparing the WHO GDM diagnostic protocol to others.

In our study, we aimed at assessing the effectiveness of the selected temporary pandemic protocols (applied in the United Kingdom [UK] and Australia during the COVID-19 pandemic) by applying their parameters to patients admitted to an outpatient clinic at the University Hospital, Cracow, Poland in 2020. We also assessed what would be the potential impact of this change on the pregnancy complications.

Methods

We performed a retrospective analysis of GDM patients attending to the outpatient clinic at the University Hospital of Cracow, Poland throughout 2020. The inclusion criterion was receiving care in the clinic between 1st January and 31st December 2020 due to GDM diagnosis. Pregnant women with other types of diabetes during pregnancy (type 1, type 2) were exluced from the analysis. From electronic medical data, we extracted information regarding each patient's age, week of pregnancy during the first visit, number of visits and televisits, dates when fasting plasma glucose (FPG) and oral glucose tolerance test (OGTT) were performed, HbA1c, body mass index (BMI), presence of GDM risk factors (obesity, age above 35 years, history of GDM, family history of type 2 diabetes, miscarriages, macrosomic babies in previous pregnancies), the mode and week of child's delivery, birthweight, obstetric complications (maternal: preterm [< 32 weeks of pregnancy] birth, miscarriage, obstetric bleeding, preeclampsia, eclampsia; child: prolonged delivery, shoulder dystocia, hypoxia, asphyxia, hypoglycemia) and newborn complications (small/large for gestational age, infections, prolonged jaundice requiring elongation of post-delivery hospital stay, hospitalization in a newborn intensive care unit).

In the first analysis, we compared the clinical characteristics of women treated at our hospital in January and March 2020, (representing the control 'pre-COVID period group), to women treated between February and December 2020 (the group to which the UK and Australian screening protocols were applied- labeled 'COVID period group). We analyzed the characteristics of patients upon presentation in both groups and compared the statistical likelihood of pregnancy and perinatal complications (please see Table 2).

In the second analysis, we also compared the GDM frequency using the standard, pre-COVID-19 and COVID-19-specific diagnostic criteria from the UK and Australia. The women were classified into the following groups based on the UK and Australian diagnostic criteria: 1) missed GDM by the COVID simplified UK criteria 2) missed GDM by the COVID simplified Australian criteria.

In the UK, during the COVID-19 pandemic, the Royal College of Obstetricians and Gynaecologists recommended risk-factor-based screening with testing HbA1c (GDM if ≥ 39 mmol/mol [5.7%]) or random plasma glucose (RPG, GDM if ≥ 9.0 mmol/L) during the first visit (usually up to 12 weeks of gestation), and when both are negative – FPG at 28 weeks of pregnancy (GDM if > 5,6 mmol/l) [11]. In Australia, universal testing was proposed – in women with risk factors for GDM, the HbA1c should be assessed during the 1st trimester (GDM is diagnosed if > 41 mmol/mol [5.9%]). When negative, a universal FPG at 24–28 weeks of gestation (GDM is diagnosed if ≥ 5.1 mmol/l, no GDM is diagnosed if < 4.6 mmol/l, and the OGTT recommended if 4.7–5 mmol/l) [12]. The summary of selected temporary guidelines for GDM screening during the COVID-19 pandemic is presented in Table 1.

Statistical analysis The PS Imago Pro ver. 7.0 was used for statistical analyses. Variables were presented as arithmetic mean ($\bar{x}$) ± standard deviation (SD) or as the median with interquartile range (IQR), or as counts and percentages. The normality of the continuous variable distribution was assessed using the Shapiro-Wilk test. Differences were analyzed with Student's t test or nonparametric tests Mann–Whitney U test. Statistical testing was completed to compare categorical variables using an independent sample Chi-squared test or Fisher's exact test when appropriate. Statistical inference was set at $p < 0.05$. Sample size calculation was performed based on already available information [13].

Table 1 Summary of temporary GDM screening and diagnosis recommendations during the COVID-19 pandemic

	RANZCOG (Australia and New Zealand)	RCOG (UK)	Diabetes Poland (based on WHO 2013)
Screening in early pregnancy (standard care)	75 g OGTT	75 g OGTT	FPG, if abnormal OGTT
Screening in early pregnancy (alternative)	HbA1c For high-risk women	HbA1c or a random plasma glucose For high-risk women	FPG, if abnormal OGTT
Screening in 24–28 weeks of gestation (standard care)	2 h OGTT	2 h OGTT	2 h OGTT
Screening in 24–28 weeks of gestation (alternative)	FPG	HbA1c and FPG or RPG	2 h OGTT

COVID-19—coronavirus disease 2019, GDM – gestational diabetes mellitus; RANZCOG—Royal Australian and New Zealand College of Obstetricians and Gynecologists, RCOG—Royal College of Obstetricians & Gynecologists, WHO – World Health Organization, RPG—Random plasma glucose, OGTT – oral glucose tolerance test; FPG – fasting plasma glucose

To achieve 80% power and 5% margin of error, a sample size of 380 was required.

Ethics The study was based on retrospective analysis of patients' medical records, and ethics approval was not required by the local regulations. Obtaining the informed consent of the patients analyzed was not required. Neither any diagnostic procedures, nor treatment methods were affected by this study. The authors were granted the permission to access and analyze the patients' data by the Hospital Board.

Results

We included a total of 432 women with GDM between the 2 groups, with mean age of 33.3 ± 4.9 years, BMI 25.3 ± 5.3. For 37.3% this was the 1st pregnancy, for 33.6% the 2nd, for 16.1% the 3rd and for the remaining 13% 4th and following. Risk factors for GDM were prevalent in 88.2% percent of patients.

In the first analysis of the pre-pandemic and COVID-19 pandemic subgroups, the COVID-19 pandemic subgroup showed a delayed first visit (median 25.5 vs. 24 Hbd [weeks of gestation], $p = 0.03$). Child perinatal complications were more prevalent in the pre-COVID-19- subgroup (69.2% vs. 39.7%, $p = 0.04$). GDM was diagnosed in the 1st trimester in 36.6% patients. The GDM diagnosis was based on FPG in 7.6%. The full characteristic of the study subgroups is presented in Table 2.

When applying the UK criteria to our cohort, 272 (63.0%) of 432 GDM cases would be missed. In the first step, 49 women without risk factors for GDM would be excluded from screening. Risk factors were prevalent in 383 women, of whom 32 were diagnosed with diabetes based on FPG and 206 underwent OGTT up to 12 weeks of gestation in our setting. If FPG or OGTT results from this group were treated as RPG, 120 cases of GDM would be identified and 118 missed, delaying the diagnosis. 263 women would be subject to the next stage of screening at 28 weeks of gestation. In this group, only 40 women had FPG ≥ 5,6 mmol, 223 cases of GDM in this step would be missed (Fig. 1).

Women with missed-GDM by the UK criteria were slightly younger and had lower BMI (32, IQR 21–27 vs. 34, IQR 30–39 years, p = 0.047; 24.0 IQR 21.4–28.3 vs. 25.5, IQR 22.3–27.9 kg/m2, $p = 0.005$). Less patients in the missed subgroup were treated with insulin (55.9% vs. 75.0%, $p < 0.001$). Finally, the frequency of child perinatal complications was lower in the missed GDM group (7.6% vs. 18.9%, $p = 0.042$). There were no differences in the frequency of maternal perinatal and newborn complications overall. Please see Table 3 for further data.

When applying the Australian criteria to our cohort, 86 of 432 (19.9%) GDM cases would be missed. GDM diagnosis in 239 women from our cohort, that were diagnosed before the 24th week of gestation, would be delayed to the 24–28 weeks of pregnancy. 86 GDM cases would be missed, 234 would be confirmed, and 112 women would require further OGTT (Fig. 2).

Women with missed-GDM by the Australian criteria had lower BMI than those not missed. Less patients in the missed subgroup were treated with insulin (48.5% vs. 75.2%, $p < 0.001$). There were no differences in the frequency of child and maternal perinatal and newborn complications overall. Please see Table 4 for further data.

Discussion

The COVID-19 pandemic posed numerous challenges to pregnancy care, especially in cases complicated by GDM [13]. In the times of this global health emergency, the standard screening for GDM had to be altered and adapted into temporary solutions. Based on a review published early during the pandemic, the two main strategy adjustments considered were: 1) risk-based screening instead of universal screening and 2) replacing OGGT with other glucose tests such as FPG, RPG, or even HbA1c [14]. Those were based

Table 2 Characteristics of GDM participants according to pre- and COVID-19 pandemic diagnostic periods (applied to patients at University Hospital in Krakow)

Characteristic	Pre-pandemic period $N=92$	COVID-19 – pandemic period $N=340$	p
Age (years)	33 (29.0–37.0)	33 (30.0–37.0)	NS
BMI (kg/m2)	23.5 (21.0–27.5)	24.3 (21.6–28.3)	NS
GDM risk factors (N, %)	79 (85.9%)	304 (89.4%)	NS
BMI > 25 (N, %)	32 (35.6%)	149 (44.3%)	NS
History of GDM (N, %)	21 (22.8%)	108 (31.8%)	NS
GDM treatment with insulin (N, %)	57 (62.0%)	215 (79.0%)	NS
Hbd. of 1st visit (weeks)	24.0 (12.0–28.0)	25.5 (14.0–29.0)	0.03
Fasting plasma glucose on 1st visit (mmol/l)	5.29 (5.1–5.78)	5.18 (4.88–5.41)	0.22
Glycemia before OGTT [mmol/l)	5.17 (4.67–5.39)	5.1 (4.66–5.36)	NS
1-h OGTT glycemia (mmol/l)	9.31 (7.79–10.28)	9.54 (7.71–10.72)	NS
2-h OGTT glycemia (mmol/l)	8.21 (6.56–9.10)	8.12 (6.36–9.02)	NS
Number of visits during pregnancy	4.5 (3.0–6.0)	5.0 (3.0–7.0)	NS
Number of telehealth visits during pregnancy	0.0	2.0 (0.0–4.0)	< 0.001
% of telehealth visits during pregnancy	0.0%	42.9% (0.0–66.7%)	< 0.001
Hbd. of delivery (weeks)	39 (38.0–39.3)	39 (38.0–39.0)	NS
Birthweight (g)	3110 (2604.0–3305.0)	2942 (2603.0–3285.0)	NS
LGA (N, %)	0.0%	6 (4.5%)	NS
Maternal delivery complications (N, %)	4 (30.8%)	28 (21.2%)	NS
Premature birth (N, %)	1 (7.7%)	2 (1.5%)	NS
Newborn delivery complications (N, %)	1 (7.7%)	16 (12.1%)	NS
Newborn asphyxia (N, %)	0 (0.0%)	14 (10.7%)	NS
Newborn hypoglycemia (N, %)	3 (23.1%)	10 (7.6%)	0.097
Newborn post-delivery complications (N, %)	9 (69.2%)	52 (39.7%)	0.04

COVID-19—coronavirus disease 2019, GDM – gestational diabetes mellitus; OGTT – 75 g oral glucose tolerance test; BMI – body mass index; Hbd. – weeks of gestation; LGA – large for gestational age

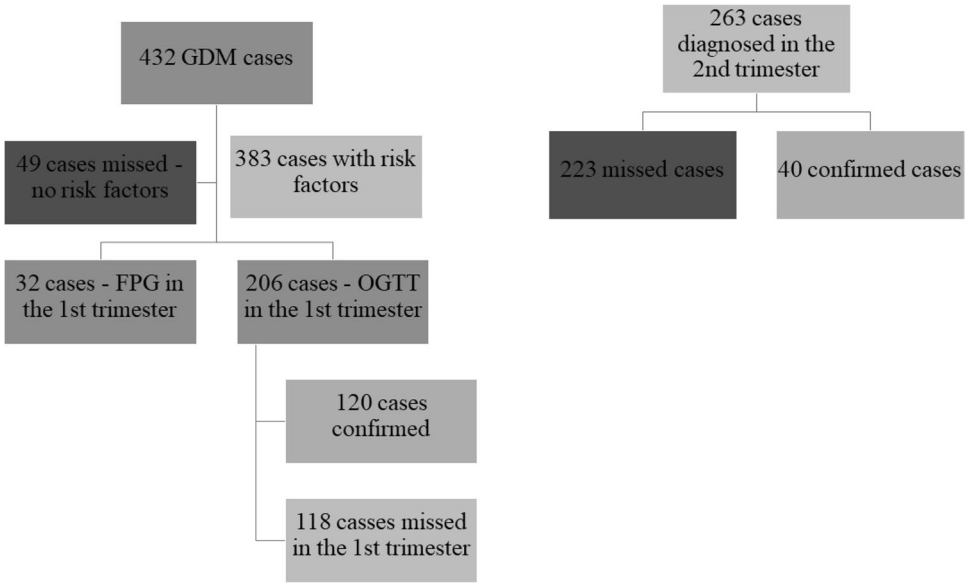

Fig. 1 Missed and confirmed cases if the UK criteria were applied to the study cohort

on the hypothesis that they would limit the risk of COVID-19 infection in pregnant women and medical staff in the clinics or laboratories by simplifying the GDM diagnostic process, thus reducing the number of face-to-face visits and promoting telehealth care [14].

Table 3 Characteristics of participants with GDM missed when UK criteria applied to University Hospital Krakow patients

Characteristic	GDM missed $N=272$	GDM confirmed $N=60$	p
Age (years)	33 (21–27)	34 (30–39)	0.047
BMI (kg/m2)	24.0 (21.4–28.3)	25.5 (22.3–27.9)	0.005
BMI > 25 (N, %)	98 (36.4%)	83 (52.9%)	< 0.001
GDM treatment with insulin (N, %)	152 (55.9%)	120 (75%)	< 0.001
Hbd. of delivery (weeks)	39 (38–39)	39 (38–39)	NS
Birthweight (g)	3325 (3030–3642)	3200 (2847–3567)	NS
LGA (N, %)	3 (3.3%)	3 (5.6%)	NS
Maternal delivery complications (N, %)	19 (21.1%)	13 (23.6%)	NS
Premature birth < 38 Hbd. (N, %)	2 (2.2%)	5 (9.1%)	0.106
Cesarean section	52 (51.0%)	43 (59.7%)	NS
Newborn delivery complications (N, %)	7 (7.6%)	10 (18.9%)	0.042
Newborn asphyxia (N, %)	7 (7.9%)	7 (12.7%)	NS
Newborn hypoglycemia (N, %)	8 (9.0%)	5 (9.1%)	NS
Newborn post-delivery complications (N, %)	41 (46.1%)	20 (36.4%)	NS

COVID-19—coronavirus disease 2019, GDM – gestational diabetes mellitus; BMI – body mass index; Hbd. – weeks of gestation; LGA – large for gestational age

Fig. 2 Missed and confirmed cases if the Australian criteria were applied to the study cohort

There were some discrepancies between screening strategies and the level of their modification vs. the standard care internationally. Each of these strategies came with advantages and disadvantages [13, 14]. Notably, those changes were made without prior knowledge of their impact on pregnancy outcomes. The current Polish guidelines include universal testing for GDM, with all women subjectable to FPG in the first trimester and then OGTT in the 24-28th weeks of gestation [3]. This approach required frequent visits in health-care facilities and was reported to significantly increase the diagnosed prevalence of GDM, as compared to risk-factor-based testing or RPG screening [5]. Nevertheless, Diabetes Poland decided not to introduce a more liberal screening strategy for GDM in the wake of COVID-19 pandemic.

In this study, we applied selected temporary strategies from the UK and Australia to a cohort of Polish GDM patients diagnosed and treated during the COVID-19 pandemic to find out to what extent the adoption of more liberal GDM diagnostic criteria would have impacted the prevalence of GDM. We also investigated the prevalence of pregnancy outcomes in this cohort.

The UK screening strategy was limited only to women with risk factors for GDM and prioritized avoiding OGTT to ensure lower exposure to SARS-Cov-2 virus in health-care facilities. This would come at the cost of missing an estimated 63% of GDM cases. Interestingly, the patients who would have fallen in this 'missed', undiagnosed group would have been less likely to require treatment with insulin when compared to the average GDM positive patient in regular pre-COVID testing. This could be interpreted as the 'missed' patients having less severe GDM than those that were identified in both the simplified and regular screening tests. More importantly, perinatal complications occurred less frequently amongst the children in this 'missed' group, indicating less severe course of

Table 4 Characteristics of participants with GDM missed with the Australian criteria

Characteristic	GDM missed $N=86$	GDM confirmed $N=346$	p
Age (years)	32 (29–37)	34 (30–37)	NS
BMI (kg/m2)	21.7 (20.2–24.2)	24.6 (22.2–28.7)	<0.001
BMI > 25 (N, %)	16 (19.3%)	165 (48.1%)	<0.001
GDM treatment with insulin (N, %)	27 (31.4%)	245 (70.8%)	<0.001
Hbd. of delivery (weeks)	39.0 (38.0–39.0)	38.0 (38.0–39.0)	NS
Birthweight (g)	3200 (2780–3500)	3310 (3050–3650)	0.059
LGA (N, %)	1 (2.9%)	5 (4.6%)	NS
Maternal delivery complications (N, %)	4 (11.4%)	28 (25.5%)	0.081
Premature birth (N, %)	2 (5.7%)	5 (4.6%)	NS
Ceasarian section	17 (44.7%)	78 (27.4%)	NS
Newborn delivery complications (N, %)	8 (11.3%)	9 (12.2%)	NS
Newborn asphyxia (N, %)	2 (5.7%)	12 (11.0%)	NS
Newborn hypoglycemia (N, %)	3 (8.6%)	10 (10.2%)	NS
Newborn post-delivery complications (N, %)	14 (40.0%)	47 (43.1%)	NS

COVID-19—coronavirus disease 2019, GDM – gestational diabetes mellitus; BMI – body mass index; Hbd. – weeks of gestation; LGA – large for gestational age

the disease or even overdiagnosis in the standard Diabetes Poland protocol.

The Australian criteria were not as radical as in the UK. Only the first step of the diagnostic process was limited (to those at risk of GDM development), but, later in pregnancy, the screening was universal. The modified Australian criteria reduced the diagnosed frequency of GDM by 20%, but also delayed the diagnosis until the 2nd trimester. Of note, the process still required two steps and performing of OGTT in the majority of women, increasing the attendance in diabetes clinics. In the subgroup of women who would be missed with the Australian criteria, insulin was also used less frequently, but there were no differences of peri- or postnatal complications.

Still, according to the available evidence, the UK guidelines adopted parameters that are not regarded as proper for GDM screening [14]. A single RPG is inadequate to screen for GDM [15]. Moreover, the FPG that was used in both screening strategies is characterized by poor specificity and giving high false-positive values [14]. The choice to use HbA1c in Australia was also not supported by evidence, as the usability of this parameter in diagnosis and monitoring of GDM is not well established [16]. What is more, different cut-off values were adopted in the UK and Australia. The UK guidelines considered thresholds for HbA1c: 5.7%, RBG: 9.0 mmol/L; and FPG: 5.3 mmol/L, whereas in Australia thresholds were as follows HbA1c: 5.7%, and FPG: 5.1 mmol/L. This being said, the significance of these cut-off points in GDM screening remains vague [14]. Some previous studies showed that the use of RBG, FPG, and HbA1c criteria alone (without an accompanying OGTT), can limit the number of GDM diagnoses by more than 60% in women with a fasting glucose $\leq$4.6 mmol/L[17]. Our results are supported by the evidence from Ireland from 2019 and 2020, where there was an underdiagnosis of GDM but still women at a higher risk of hyperglycemia were correctly identified. The authors concluded that OGTT should be maintained as the gold-standard test if possible, ensuring adequate social distancing during testing [18].

Our study adds to the long-term discussion on the most appropriate approach to GDM screening and diagnosis. Since the publication of the HAPO study and the adoption of its results by the WHO/IADSPG, plenty of new evidence has emerged. Still, these criteria are not universally accepted and are being challenged [19]. In a systematic review with metaanalysis, it was revealed that the prevalence of GDM increased with updates of screening methods and with lowered positive thresholds in diagnostic criteria [5]. Another review focused on examining the adverse effects associated with applying different criteria. The risk of adverse effects was not affected by the GDM screening and diagnostic criteria used. The authors concluded that this data should inform health-care-providers in the choice of the most cost-effective approach for GDM screening [20]. A recent randomized control study showed that women and their offspring diagnosed with higher GDM cut-off points are not at risk of perinatal complications, including macrosomia, with no clear benefits for women in lower threshold group, with WHO/IADSPG criteria may lead to GDM overdiagnosis in ca. 65% patients [8]. Thus, 3 out 5 women with GDM in Poland that are diagnosed with the current criteria, would not be diagnosed with GDM.

The COVID-19 pandemic appeared to pose a serious threat to the quality and continuity of care for pregnant

patients with GDM, as one would assume that undiagnosed women would be at higher risk of pregnancy complications. Nevertheless, our opinion is that it should be treated as an opportunity to evaluate and adjust current clinical practices.

Considering the impact of the pandemic itself on the patients' care, when comparing women with GDM treated before and during the pandemic, we found the GDM diagnoses were made slightly later during the pregnancy. As may be suspected, a large portion of visits during the pandemic were performed with telehealth methods with such type of care nonexistent before in our clinic. As reported before the pandemic, and later confirmed by further insights during the outbreak, it did not result in worse metabolic control in patients or higher risk of pregnancy complications [21–24]. Interestingly, the frequency of child perinatal complications was lower during the COVID-19 pandemic [23]. In our population telehealth visits were common. As presented in previous studies, the use of telemedicine was associated with less maternal and neonatal/fetal complications, potentially explaining the change.

This study is one of the first to attempt to apply various liberal GDM screening strategies to a relatively large and homogenous, single-region cohort. This is a major strength and distinguishing factor of our research. Moreover, our study yielded results similar to recent high-quality RCT studies, further supporting its validity.

The main limitation of the study is that it was a retrospective analysis of patients' data, that may have introduced potential selection and information bias regarding the quality of analyzed original data. Randomized controlled trial (RCT) is most suitable for acquiring reliable data on the subject, however during the COVID-19 pandemic those were extremely rare due to safety concerns. As there could have been multiple confounding factors, such as impact of insulin use in pregnancy and newborn complications, our results should be considered with caution. Lastly, we assumed that the results of a single glucose test (either FPG or OGTT) would yield similar results if repeated, though the reproducibility of glucose testing in pregnancy is known to be poor and glucose values can vary by a considerable margin.

Conclusions

Protocol modifications proposed in the UK and Australia during COVID-19 resulted in varying decreases and delays in GDM diagnoses when applied to patients in our cohort. However, an increased risk of pregnancy complications was not observed among the women undiagnosed ('missed') when screening with the temporary criteria. We acknowledge that these new criteria may be of probable benefit due to less potential exposure to COVID-19 or any similar future large-scale health crises due to an outbreak of infectious disease.

This study, among many, suggests that the regular, commonly used WHO protocol can lead to GDM overdiagnosis. Future research should thus focus on the evaluation of proposed cutoff values and their diagnostic significance in GDM screening, and even more importantly on assessing the impact of the temporary protocols on hyperglycemia-related pregnancy outcomes and the long-term child condition.

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Data Availability The data analyzed in the paper is available from the corresponding author on reasonable request.

Declarations

The authors did not receive support from any organization for the submitted work.
The authors have no relevant financial or non-financial interests to disclose.
The study was based on retrospective analysis of patients' medical records, and ethics approval was not required. Obtaining the informed consent of the patients analyzed was not required. Neither any diagnostic procedures, nor treatment methods were affected by this study. The authors were granted the permission to access and analyze the patients' data by the Hospital Board.

Conflict of Interest The authors have no relevant financial or non-financial conflicts of interests to disclose.

Ethical clearance The study was based on retrospective analysis of patients' medical records, and ethics approval was not required. Obtaining the informed consent of the patients analyzed was not required. Neither any diagnostic procedures, nor treatment methods were affected by this study. The authors were granted the permission to access and analyze the patients' data by the Hospital Board.

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