ORIGINAL ARTICLE

Universal Early Gestational Diabetes Mellitus Screening: A Prospective Multicenter Study in Thailand

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Objective: To study the prevalence of early-onset gestational diabetes mellitus (GDM) and clinical characteristics from universal early antenatal screening in Thai pregnant women.

Materials and Methods: A multicenter prospective study in multi-level of hospitals in Thailand was conducted between May and September 2024. All pregnant women attending antenatal clinic before 20 weeks of gestation were screened for GDM using the two-step method. A 50-g glucose challenge test (GCT) at first antenatal care followed by a diagnostic 100-g oral glucose tolerance test (OGTT). The glucose screening test was repeated between 24 and 28 weeks if the earlier testing was negative. The prevalence of early-onset GDM and their clinical characteristics of GDM were evaluated.

Results: Eight hundred eighty-four pregnant women participated in the present study. The participants were found to have low, intermediate, and high risk of GDM of 19.46%, 42.31%, and 38.24%, respectively. The prevalence of early-onset GDM was 11.09% (95% CI 9.09 to 13.34). The glucose screening test was positive in 22.09%, 21.39%, and 42.01%, and the early-onset GDM was detected in 3.49%, 6.68%, and 19.82% of the low, intermediate, and high-risk groups, respectively. The significant associated factors of early-onset GDM were maternal age of 35 years or older, maternal age between 25 and 34 years, BMI of 30 kg/m^2 or more, a first degree relative with diabetes, and history of GDM in previous pregnancy.

Conclusion: Universal early GDM screening in Thailand can detect a high prevalence of GDM in asymptomatic pregnant women. The early detection leads to early control of blood glucose levels. However, the impact of this protocol still needs further investigation.

Keywords: Gestational diabetes; Early-onset; Universal screening; Prevalence; Associated factors

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Gestational diabetes mellitus (GDM) is defined as any degree of glucose intolerance with the onset of first recognition during pregnancy[1], which is one of the most common medical conditions during pregnancy. International Diabetes Federation (IDF) reported that about 21.1 million or 16.7% of women had hyperglycemia during pregnancy[2], which the majority (84%) is GDM[3]. The prevalence of diabetes in pregnancy varies between countries and Southeast Asia is reported to have an overall higher GDM prevalence than any other global regions. According to the 2019 IDF report, Thailand had the highest GDM prevalence rate in this area at 24.7%, followed by Singapore at 23.5%, Malaysia at 22.5%, and Vietnam at 21.3%[4]. Diabetes in pregnancy increases the complication for both mother and the baby, such as risk of miscarriage, fetal anomalies, preeclampsia, large for gestational age infants, fetal macrosomia, obstructed labor, and shoulder dystocia[5].

The importance of early detection of gestational diabetes is crucial for prompt management to prevent both maternal and fetal complications[2]. However, the optimum method of detecting early gestational diabetes is still unclear. The International Association of Diabetes and Pregnancy Study Groups (IADPSG)[6], and the American College of Obstetricians and Gynecologists (ACOG)[7] suggest targeting early screening to individuals at increased risk of diabetes, including Asian Americans. The

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American Diabetes Association (ADA)[8] suggests that clinicians consider testing all individuals for undiagnosed diabetes at the first prenatal visit. However, the Royal Thai College of Obstetricians and Gynecologists (RTCOG) and Ministry of Public Health of Thailand have recommended early GDM screening only for those at high risk of diabetes mellitus (DM)[9]. As a consequence of the high prevalence of diabetes in Thailand, a previous Thai study found high prevalence of early GDM from universal early screening in a university hospital setting[10]. Therefore, this multicenter prospective study was conducted in multi-level of hospitals with the aim of evaluating the results of universal early gestational diabetes screening in Thailand.

Materials and Methods

The present study was a multicenter prospective cohort study with repeated cross-sectional analysis in multi-level of hospitals in Thailand. After the approval of the Udonthani Hospital Ethical Committee for Human Research (No. 92/2567), the pregnant women attending antenatal care before 20 weeks of gestation, between May and September 2024, at Udonthani Hospital, Na Klang Hospital, Sawangdandin Crown Prince Hospital, Kumpawapi Hospital, Ban Phue Hospital, Phen Hospital, Ban Dung Hospital, Wanon Niwat Hospital, and Nong Han Hospital, were invited to participate in the present study. The exclusion criteria were women with pre-existing diabetes. All participants gave their informed written consent before participating in the present study.

Early screening of gestational diabetes is the screening before 24 weeks of gestation[11]. A 2-step approach was used that included a 50-g glucose challenge test (GCT) for screening and a 100-g oral glucose tolerance test (OGTT) for GDM diagnosis. The glucose screening test was repeated between 24 and 28 weeks if the earlier testing was negative. An ACOG criteria was used for GDM diagnosis by using glucose at 140 mg/dL or more as the cut-off value for positive screening test and the Carpenter and Coustan criteria was used for GDM diagnosis[12]. The blood glucose was tested using plasma from venous blood collected in sodium fluoride preservation tubes.

High risk for gestational diabetes was defined as the pregnant women who were aged 35 years or older, body mass index (BMI) of 30 kg/m² or more, history of diabetes in first-degree relative, history of GDM or birth of macrosomia infant in previous pregnancy, history of impaired glucose tolerance test, history of polycystic ovarian syndrome, or steroid use[12]. Low risk was defined as those who were younger than 25 years, had a BMI of less than 23 kg/m², had no history of previous glucose intolerance or adverse pregnancy outcomes associated with GDM, and had no first-degree relative with diabetes[13]. Intermediate risk was those who were neither in the low or the high-risk groups.

Early-onset GDM was defined as GDM diagnosed before 24 weeks of gestation and late-onset GDM was defined as GDM diagnosed at or after 24 weeks. All GDM cases were initially treated with diet control, nutritionist counselling, and glucose monitoring. Pharmacological treatment using metformin and insulin were used if necessary.

The sample size was calculated by N4studies application using a formula for a descriptive study. An estimated proportion of GDM diagnosed by early screening in Thai people was 9.2%[10] with a 0.02 error. The calculated sample size was 803 cases, then a further 10% was added. The total sample size was 884 cases.

The clinical characteristics were presented in terms of number, percentage, mean and standard deviation. The proportion of early-onset GDM was presented as a percentage with a 95% confidence interval (CI). The prevalence of early GDM in low-risk, intermediate-risk and high-risk groups were reported as a percentage. Generalize linear model was used to analyze associated factors and were presented as a risk ratio with a 95% CI.

Results

Eight hundred eighty-four women participated in the present study. Early-onset GDM was found in 98 out of 884 cases (11.09%) (95% CI 9.09 to 13.34). The clinical characteristics are shown in Table 1. Participants with low, intermediate, and high risk of GDM were 172 cases (19.46%), 374 (42.31%), and 338 (38.24%), respectively. The early GDM screening was done using the 2-step test, the GCT was positive in 38 cases (22.09%), 80 (21.39%), and 142 (42.01%) of the low, intermediate, and high-risk groups, respectively. The early-onset GDM was detected in six cases (3.49%), 25 (6.68%), and 67 (19.82%) of the low, intermediate, and high-risk groups, respectively. The details of each diabetic risk are shown in Table 2.

The risk ratios of each possible associated factor are shown in Table 3. The highest GDM risk was found in the age group greater than or equal to 35 years with an adjusted risk ratio of 9.33 (95% CI 3.69

Table 1. Clinical characteristics

Characteristics	Total (n=884); n (%)
Age (years)	
Mean±SD	27.11±6.55
<20 years	123 (13.91)
20 to 34 years	641 (72.51)
≥35 years	120 (13.58)
Gravida	
Mean±SD	1.96±1.02
Primigravida (G1)	345 (39.03)
Multigravida (G ≥2)	539 (60.97)
Previous abortion	136 (15.38)
Education	
Less than bachelor degree	755 (85.41)
Bachelor degree or higher	129 (14.59)
Income (Baht/year)	
<180,000	422 (47.74)
≥180,000	462 (52.26)
Pre-pregnancy BMI (kg/m^2)	
Mean±SD	23.75±5.06
Underweight (<18.5)	119 (13.46)
Normal (18.5 to 22.9)	324 (36.65)
Overweight (23 to 29.9)	328 (37.10)
Obesity (≥30)	113 (12.78)
Diabetic risk	
Low	172 (19.46)
Intermediate	374 (42.31)
• Age 25 to 34 years	287 (76.74)
• BMI 23 to 29.99 kg/m^2	219 (58.56)
High	338 (38.24)
• Age ≥35 years	120 (35.50)
• BMI ≥30 kg/m^2	113 (33.43)
• DM in first-degree relative	164 (48.52)
• GDM in previous pregnancy	14 (4.14)
• Macrosomia in previous pregnancy	10 (2.96)

SD=standard deviation; BMI=body mass index; DM=diabetes mellitus; GDM=gestational diabetes mellitus

to 23.61). The age group 25 to 34 years, BMI of 30 kg/m² or greater, history of diabetes in a first-degree relative, and history of GDM in previous pregnancy were also at risk of early-onset GDM.

Discussion

The prevalence of early-onset GDM in Thai women from universal screening in the present study was 11.09% (95% CI 9.09 to 13.34). Three-point-forty nine percent of the low-risk group, 6.68% of the intermediate-risk, and 19.82% of the high-risk group were found to have early-onset GDM. The maternal age of 35 years or older, and between 25 and 34 years, those with a BMI of 30 kg/m² or greater, a first degree relative with diabetes, and history of GDM in previous pregnancy were the significant risk factors of early-onset GDM.

Table 2. Proportion of early-onset gestational diabetes in each diabetic-risk group (n=884)

Diabetic risk	Positive GCT n (%)	Early-onset GDM n (%)
Low	38 (22.09)	6 (3.49)
Intermediate	80 (21.39)	25 (6.68)
Age 25 to 34 years	72 (25.09)	24 (8.36)
BMI 23 to 29.99 kg/m^2	47 (21.46)	9 (4.11)
High	142 (42.01)	67 (19.82)
Age ≥35 years	58 (48.33)	31 (25.83)
BMI ≥30 kg/m^2	53 (46.90)	25 (22.12)
DM in first-degree relative	74 (45.12)	36 (21.95)
GDM in previous pregnancy	9 (64.29)	6 (42.86)
Macrosomia in previous pregnancy	5 (50.00)	0 (0.00)

BMI=body mass index; DM=diabetes mellitus; GCT=glucose challenge test; GDM=gestational diabetes mellitus

The changing nature of modern life, a sedentary lifestyle and overnutrition, leads to an increase in unrecognized type 2 diabetes mellitus in the younger-than-40-years group[14,15], which cases are asymptomatic and without risk factors[16]. Xie et al. reported the global age standardized incidence rate of type 2 diabetes mellitus in adolescent and young adults, with age between 15 to 39 years, increased from 1.17% in 1990 to 1.83% in 2019[17]. However, World Health Organization reported the age-adjusted prevalence of impaired glucose tolerance and diabetes at age 20 to 79 years, was 15.5% worldwide and 9.7% among Thai people in 2021[18].

Undiagnosed and untreated diabetes mellitus during the early stages of pregnancy may increase the risks of complications such as miscarriage and fetal anomalies[19-21]. Universal early-GDM screening can detect early-onset GDM, especially in the low to intermediate-risk cases that were not tested in the risk based GDM screening. The prevalence of early-onset GDM from this multi-level hospital study is close to the previous prospective university hospital-based studies in Thailand that reported early-onset GDM prevalence was 9.20% to 13.54%[21,22], but higher than a retrospective cohort study that reported only 3.18% early-onset GDM prevalence[23]. This prevalence is lower than the prevalence of overall GDM in Thailand that was reported by the World Health Organization, which was 25.1% in 2021[18].

The benefit of universal versus risk-based early GDM screening is still controversial. Perinatal

Table 3. Associated factors of early-onset GDM

Factors	Early-onset GDM (n=98)	Non-early-onset GDM (n=786)	Risk ratio (95% CI)	p-value	Adjusted risk ratio (95% CI)	p-value
Age 25 to 34 years (ref: age <25)	57	372	4.45 (2.31 to 8.58)	<0.001*	6.07 (2.56 to 14.39)	<0.001*
Age ≥35 years (ref: age <25)	31	89	8.65 (4.38 to 17.11)	<0.001*	9.33 (3.69 to 23.61)	<0.001*
Multipara (ref: nullipara)	66	431	1.61 (1.08 to 2.40)	0.021*	0.78 (0.49 to 1.25)	0.308
Bachelor degree or higher (ref: less than bachelor degree)	20	109	1.55 (0.95 to 2.55)	0.083	0.83 (0.51 to 1.35)	0.442
Income ≥180,000 Baht (ref: income >180,000)	56	406	1.23 (0.81 to 1.86)	0.329		
BMI 23 to 29.9 kg/m^2 (ref: BMI 18.5 to 22.9)	36	292	0.99 (0.64 to 1.53)	0.956		
BMI ≥30 kg/m^2 (ref: BMI18.5 to 22.9)	25	88	1.99 (1.25 to 3.16)	0.004*	2.08 (1.34 to 3.22)	0.001*
DM in first-degree relative	36	128	2.55 (1.75 to 3.71)	<0.001*	2.37 (1.65 to 3.41)	<0.001*
GDM in previous pregnancy	6	8	4.05 (2.15 to 7.65)	<0.001*	2.54 (1.68 to 3.82)	<0.001*

CI=confidence interval; BMI=body mass index; DM=diabetes mellitus; GDM=gestational diabetes mellitus
* p<0.05 was statistically significant, variables with p≥0.2 were included in generalize linear model

mortality is greater in the early-onset GDM when compared to late-onset GDM women[24]. The ADA recommended that clinicians consider testing all individuals for undiagnosed diabetes at the first antenatal visit using standard diagnostic criteria if not screened preconception. However, the United States Preventive Service Task Force (USPSTF) concluded that current available evidence was insufficient to assess the benefits of universal early glucose intolerance screening in asymptomatic pregnant women[11]. In the present study, the low and intermediate risk were found in 62.10% of pregnant women. However, the prevalence of early-onset GDM in the low and intermediate-risk group were 3.49% and 6.68%, which might not be detected in the risk-based early screening. If these individuals were identified earlier, they could benefit from receiving early treatment. The result of the present study suggested that early GDM screening in countries with a high prevalence of GDM should be practiced.

The associated factors of early-onset GDM in the present study were maternal age, obesity, and having diabetes in first-degree relative, which was similar to Sirirat et al. and Boriboonhirunsarn et al. studies that reported the adjusted odds ratio of maternal age of 25 to 29 years was 2.21 (95% CI 1.07 to 4.57) and age of 30 years or older was 4.89 (95% CI 2.08 to 11.50) [22,25]. Harper et al. study reported the early screening detected early-onset GDM in 6.3% of obese pregnant women, with a BMI of 30 kg/m² or greater, while the present study founded 22.12% of this group had early-onset GDM[26]. Monod et al. study reported that pregnant women with diabetic first-degree relatives had OR 1.91 (95% CI 1.16 to 3.16) of GDM, which is close to the findings of the present study[27].

The strength of the present study is a multi-level hospital study in Thailand involving the tertiary, general, and community hospitals. The limitations are the focus of the present study, which was on early GDM screening, the results of late screening at 24 to 28 weeks gestation, and the outcomes of pregnancy still need to be analyzed further. The randomized controlled study to compare the outcomes of universal and risk-based early GDM screening is also needed to evaluate the impact of both screening methods to pregnancy outcomes.

Conclusion

Universal early GDM screening in Thailand can detect high prevalence of GDM in asymptomatic pregnant women. The early detection leads to early control of blood glucose level; however, the impact of this screening protocol still needs further investigation.

What is already known about this topic?

GDM is common in Thailand and Southeast Asia. It can increase pregnancy complications such as abortion, fetal anomalies, large for gestational age, and fetal macrosomia.

What does this study add?

The universal early screening of GDM in multi-level of hospitals in Thailand can detect high prevalence of early-onset gestational diabetes. Routine early screening should be considered in antenatal care protocol of Thailand.

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Data availability

The data that supports the findings of the present study is available on request to the corresponding author within five years after publication.

Authors' contributions

MS, SS, and RC contributed to the study conception and design. Material preparation and data collection were performed by MS, RC, SS, SN, PM, CN, KS, NL, and AS. Data analysis was performed by MS. The first draft of the manuscript was written and reviewed by MS and SS. All authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

Conflicts of interest

The authors report no conflicts of interest.

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