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Original Research Article

Universal screening for gestational diabetes mellitus with diabetes in pregnancy study group India criteria and maternal and fetal outcome in gestational diabetes mellitus patients

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ABSTRACT

Background: The aim of the study was to estimate the incidence of gestational diabetes mellitus (GDM) among antenatal patients and to evaluate the maternal and neonatal complications in GDM cases and compare it with non GDM controls.
Methods: This prospective study was conducted at Bebe Nanki maternal and child care centre, Amritsar in the department of obstetrics and gynecology from September 2022 to August 2023. A total of 2600 antenatal patients were screened for GDM using DIPSI (diabetes in pregnancy study group India) criteria. Maternal and fetal outcomes were compared in 200 GDM cases and 200 non GDM controls.
Results: Incidence of GDM was found to be 8.69% (226/2600). The mean age of GDM cases v/s controls was 29±5.53 years v/s 26.75±4.55 years respectively. Mean BMI of GDM cases v/s controls was ≥24 kg/m^2 v/s 18.5-23.9 kg/m^2. Majority of GDM cases 117 (58.5) and controls 140(70%) delivered at term via LSCS (53% cases v/s 49.5% controls delivered via LSCS). Antenatal complications like HDP (17.5% v/s 8%), preterm labour (40.5% v/s 29.5%) and polyhydroamnios (19.5% v/s 1.5%) were more common among GDM cases v/s controls. Surgical site infections (11% v/s 2.5%) and UTI (24% v/s 6%) incidence was higher in GDM cases compared to controls. Neonatal complications like NICU admission (21% v/s 7.5%), sepsis (12% v/s 5.5%) and hypoglycaemia (37.5% v/s 1%) were higher in infants of GDM mothers.
Conclusions: Early detection and timely management of GDM cases can improve foetomaternal outcome.

Keywords: GDM, Fetomaternal outcome, Universal screening

INTRODUCTION

Diabetes in pregnancy is defined as pregnancy in a previously known diabetic patient or hyperglycaemia which is diagnosed for first time during pregnancy that meets the WHO criterion for diabetes mellitus in the non-pregnant state. However, GDM is hyperglycaemia which is diagnosed for first time during pregnancy which can occur anytime during pregnancy but most likely occurs after 24 weeks.

GDM is a rapidly escalating public health problem with rising incidence among all age groups. GDM incidence varies from 1 to 14% in the world (5-8% in Asia including India) depending upon the ethnicity, selection criteria and diagnostic tests performed.[1]

GDM not only adversely affects mother but also increases perinatal morbidity and mortality. It predisposes two generations at risk for metabolic syndrome and diabetes mellitus in future. Early detection

can aid in achieving adequate glycemic controls preventing maternal and neonatal morbidity and mortality. Thus, the need for screening for GDM arises. But the question is who should be screened for GDM? Whether universal screening or selective screening approach to be followed? The fifth international workshop conference on gestational diabetes gave risk evaluation for diagnosing GDM and recommended selective screening for GDM.[1]

However, ACOG (American college of obstetrics and gynaecology) has now recommended universal screening for all pregnancies in 2017.[1] In India, where the majority of people live in rural areas and where the incidence of GDM is high (Indian women are 11 times more prone to have GDM compared to Caucasian women), a universal screening approach that is easy to use, affordable, and convenient is needed for diagnosis of GDM.[1] Thus NHM guidelines 2014 recommended universal screening of pregnant females for GDM using DIPSI criteria.

Thus, this study was undertaken to estimate the incidence of GDM and evaluate maternal and fetal outcome in GDM patients.

METHODS

This prospective study was conducted among the pregnant females who visited antenatal clinic in the department of obstetrics and gynaecology, Bebe Nanki Mother and child care centre, government medical college, Amritsar, with the permission of institutional ethics committee, government medical college, Amritsar. The study was done from 1st September 2022 to 31st August 2023 and all the antental females (2600) visiting Bebe Nanki mother and child care centre (both OPD and IPD) during this period were screened for GDM. Following were the exclusion criterias while selecting the study group-those with known pre-gestational diabetes, chronic kidney disease/ heart disease/ liver disease/ pulmonary disease, on drugs that affects glucose metabolism (e.g. corticosteroid).

Prior written informed consent was taken from all the cases. Detailed history, clinical evaluation and socio-demographic profile was noted. All the pregnant females were subjected to non-fasting 75 gm anhydrous oral glucose. 75 grams glucose was dissolved in 300 ml water and pregnant women were instructed to take it within 5 min and time was noted. If vomiting occurred within 30 minutes of oral glucose intake, the test was repeated next day. If vomiting occurred after 30 minutes, the test was continued. After 2 hours of giving glucose load, venous blood sample was collected. Blood sample collected in sodium fluoride vacutainers was subjected to centrifugation. Plasma was analysed for glucose levels by GODPOD (Glucose oxidase peroxidase) method. Values of ≥140 mg/dL at 2 hours were labelled positive with the DIPSI criteria. All the GDM patients were followed with medical nutrition therapy (MNT) after which insulin/oral hypoglycaemic agents was given if required. Majority of GDM cases 152 (76.00%) were managed with MNT (medical nutrition therapy) alone while 36 (18%) GDM cases were managed with MNT and insulin therapy both. The 12 (6.00%) GDM cases were managed were oral hypoglycaemic drugs.

Testing for GDM was done twice during pregnancy. All the pregnant females during their first visit to the OPD were subjected to the testing. First testing was done as early as possible in pregnancy and the second testing was done during 24 to 28 weeks of pregnancy if the first test was negative. There was at least 4 weeks gap between the two tests. If pregnant women came beyond 28 weeks of pregnancy, only one test was done.

The parameters taken into account included maternal age, residence, BMI, blood sugar levels after DIPSI, Obstetrical complications like HDP, preterm labour, polyhydroamnios, PPH, prolonged labour, UTI, SSI, puerperal sepsis, mode of delivery, time of delivery, neonatal birth weight, APGAR, respiratory distress syndrome (RDS), sepsis, requirement of NICU admission. The patient's clinico-demographic profiles and levels of blood glucose were correlated for descriptive statistics. All antenatal patients vising BNMCCC (both OPD and IPD) as per inclusion and exclusion criteria during study period (2600) were screened for GDM out of which 226 came out to be GDM positive. 26 of them were lost to follow up. Out of those who were found GDM positive and delivered at BNMCCC (200 GDM cases were included in group A), maternofoetal outcomes were evaluated and compared with similar number (200) of non GDM controls (Group B). While group A included all GDM positive cases delivered at BNMCCC, group B included 200 non GDM cses which were selected ny simple random sampling method. Data was analysed using SPSS (version 21; IBM Corporation).

RESULTS

Incidence of GDM was found to be 8.69% (226/2600). 43.5% of the GDM cases (Group A) were detected in third trimester while 25.5% and 31% were detected to be GDM positive in first and second trimester respectively.

Table 1 shows socio-demographic profile of study population. In this study, majority of the GDM cases (47.5%) and non GDM controls (61.5%) belonged to the age group of 21-30 years with comparable mean age in both GDM cases and non GDM controls (28.62±6.10 years versus 26.51±4.76 years). Majority of cases (82%) and controls (75.5%) belonged to rural area. Using chi square test, the data was analysed statistically and the result was found to be statistically insignificant thus showing that cases and controls had similar rural and urban distribution. Study subjects were comparable with respect to parity in both the groups (75% GDM cases versus 76% non GDM controls were multigravidas) 51% GDM cases versus 15.5% non GDM controls had family

history of diabetes mellitus. Thus, family history was found to be important risk factor for GDM. Pre-pregnancy BMI >23.9 kg/m^2 is considered as a risk factor for GDM. 49% GDM cases had BMI between 24-28.9 kg/m^2. Incidence of GDM seen to be statistically significant with BMI more than/equal to 34 kg/m^2 (p=0.001).

Table 1: Socio demographic profile.

Parameters	GDM cases	Controls
Mean age (in years)	28.62±6.10	26.51±4.76
Area		
Rural	82%	75.5%
Urban	18%	24.5%
Parity		
Primigravida	25%	33%
Multigravida	75%	67%
Family history of GDM	51%	15.5%
BMI (kg/m^2)		
18.5-23.9	21.0	53.0
24.0-28.9	49.0	31.0
29.0-33.9	23.5	14.0
≥34.0	6.5	2.0

Table 2 shows gestational age at delivery of GDM cases and non GDM controls. 58.5% GDM cases and 70% non GDM controls delivered at term (≥37 weeks). Preterm deliveries were mostly due to associated complications like eclampsia, colour doppler changes, spontaneous preterm labour.

Table 3 shows mode of delivery. LSCS was most common mode of delivery in 53% versus 49.5% while other modes of delivery were NVD (23.5% versus 36%); preterm vaginal delivery (17.5% versus 10%); IUD vaginal delivery (5.5% versus 4%) in GDM cases and non GDM controls respectively. While one case had hysterectomy in both the groups due to placenta acreta and intractable PPH respectively.

Table 4 describes maternal complications associated with GDM. HDP seen in 17.5% vs 8%, preterm labour-40.5% vs 29.5%, polyhydroamnios -19.5% vs 1.5% in GDM cases versus non GDM controls were significantly associated antenatal complications.

Intrapartum complications like PPH were seen in 5% versus 4.5% while prolonged labour was seen in 13% versus 10.5% in GDM cases versus the non GDM controls.

Postpartum maternal complications like surgical site infection was seen in 11% versus 2%; UTI-24% versus 6%; pyrexia 5.5% versus 2.5% and puerperal sepsis 3% versus 2% in GDM cases versus non GDM controls.

Table 5 shows Birth weights of neonates. Majority of cases and controls (64.5% vs 69%) delivered infants with birth weight between 2.5-3.99 kg. Among the GDM cases macrosomia (baby weight >4 kg) was found in 5 (2.5%) while it was found in 1 (0.5%) control.

Table 6 shows neonatal complications associated with GDM. Significant association was seen between neonatal hypoglycaemia (37.5% versus 1%), NICU admissions (21% versus 7.5%) in GDM versus non GDM controls. Among the neonatal complications, IUD (7% versus 4%), APGAR<7 (6.5% vs 4%), respiratory distress syndrome (6% versus 2.5%), sepsis (12% versus 5.5%), hyperbilirubinemia-8% versus 6% in GDM cases versus non GDM controls respectively.

Table 2: Gestational age at delivery wise distribution of cases and controls.

Delivery at (weeks)	Group A cases (GDM)		Group B controls (Normal)		P value
	N	%	N	%	
28-31.6	6	3.0	2	1.0	N/A
≥32-33.6	17	8.5	6	3.0	0.959
≥34-36.6	60	30.0	52	26.0	0.925
≥37	117	58.5	140	70.0	0.010
Total	200	100.0	200	100.0	

Table 3: Mode of delivery wise distribution of cases and controls.

Mode of delivery	Group A cases (GDM)		Group B controls (Normal)		P value
	N	%	N	%	
LSCS	106	53.0	99	49.5	0.19528
NVD	47	23.5	72	36	0.074868
PTVD	35	17.5	20	10.0	0.238798
IUDVD	11	5.5	8	4.0	0.440381
Peripartum hysterectomy	1	0.5	1	0.5	0.5
Total	200	100.0	200	100.0	

Table 4: Maternal complications in GDM cases and controls.

Maternal complications	Group A cases (GDM)		Group B controls (Normal)		P value
	N	%	N	%	
HDP	35	17.5	16	8.0	0.004
Preterm labour	81	40.5	59	29.5	0.0001
Polyhydroamnios	39	19.5	3	1.5	0.0001
PPH	10	5.0	9	4.5	0.814
Prolonged labour	26	13	21	10.5	0.417
Pyrexia	11	5.5	5	2.5	0.126
Surgical site infection	22	11	4	2	0.034
UTI	48	24.0	12	6.0	0.0001
Puerperal sepsis	6	3.0	4	2.0	0.522

Table 5: Birth weight of neonates in cases and controls.

Birth weight of neonates (in kg)	Group A cases (GDM)		Group B controls (Normal)		P value
	N	%	N	%	
1.00-1.49	27	13.5	8	4	0.100
1.50-1.99	15	7.5	6	3	0.796
2.00-2.49	24	12	47	23.5	0.059
2.50-3.99	129	64.5	138	69	0.180
≥4.00	5	2.5	1	0.5	N/A
Total	200	100	200	100	

Table 6: Neonatal complications of neonates in cases and controls.

Neonatal complications	Group A cases (GDM)		Group B controls (Normal)		P value	95% (CI)
	N	%	N	%		
IUD	14	7.0	8	4.0	0.188	1.806 (0.741-4.407)
APGAR<7	13	6.5	8	4.0	0.262	1.668 (0.676-4.118)
NICU admission	42	21.0	15	7.5	0.0001	3.278 (1.752-6.135)
Respiratory distress syndrome	12	6.0	5	2.5	0.083	2.489 (0.860-7.202)
Sepsis	24	12.0	10	5.5	0.012	2.591 (1.205-5.572)
Hypoglycemia	77	37.5	2	1.0	0.0001	61.976 (14.955-256.839)

DISCUSSION

In this study, incidence of GDM was seen in 8.69% (226/2600) close to 8.33% given by Kalyani et al.[3]

Insulin resistance is seen in normal pregnancy resulting in increased insulin secretion by pancreatic beta cells. There is decrease in renal threshold for glucose reabsorption from glomerular filtration. Insulin secretion rises by 200-250% during a normal pregnancy to make up for 50% reduction in the insulin-mediated whole body glucose elimination needed for a normoglycemic condition.[4] When a pregnant woman cannot make enough insulin to offset her usual insulin resistance, GDM develops.[1] Early pregnancy is associated with insulin sensitivity, which raises the risk of hypoglycemia. Additionally, the first trimester's usual nausea and vomiting lead to a decrease in food intake, which raises the risk of hypoglycemia. In contrast, towards the middle of the second and third trimesters, insulin resistance begins to develop in order to provide nutrition to the developing fetus. Thus after 26 weeks of pregnancy, gestational diabetes is common.[1,5] This is in concordance with present study in which 25.5% GDM cases were detected in 1st trimester, 31% GDM cases were detected in 2nd trimester and majority i.e., 43.5% cases were detected in 3rd trimester.

The prevalence of GDM varies with the geographical location. Since Urban populations lead sedentary lifestyles, have higher consumption of processed foods and have higher obesity rates, all of which are risk factors for GDM and also the greater accessibility of health care facilities in urban regions leading to early diagnosis of GDM, thus GDM is expected to be higher in urban population compared to rural. Incidence of GDM was seen to be greater in rural areas in the present study, as maximum number of the study population (82% cases versus 75.5% controls) belonged to these locations. According to a study by Seshiah et al the prevalence of GDM was determined to be 17.8%, 13.8%, and 9.9% in urban, semi-urban, and rural areas, respectively.[6]

Since increasing maternal age is associated with decreased insulin sensitivity and beta-cell function, older age group is more prone to develop GDM. Additionally, pre-existing diseases including obesity and hypertension, which are risk factors for GDM, are more common in older women. In this study, the mean age of cases versus controls was 28.62±6.10 versus 26.51±4.76 years respectively. Maximum incidence of GDM was found in age group 21-30 years in both cases and non GDM controls as maximum number of pregnant females belonged to this age group. In meta-analysis conducted by Li et al in involving 120 million participants, it was seen that GDM risk exhibited a linear relationship with advancing maternal age (P_{trend}<0.001).[7] The risk of GDM increased by 7.90%, 12.74%, and 6.52% for the general population, Asians, and Europids, respectively, for every year that a mother's age was raised above 18 years. Asian women had a considerably higher risk of acquiring GDM than Europid women starting at age 25 (all Pinter actions<0.001), according to subgroup analyses.

In this study, incidence of GDM was found higher in those with family history of GDM (51%) and in patients with BMI ≥24 kg/m^2. Meta-analysis carried out by Sitorukmi et al demonstrated that risk of GDM was 2.08 times higher in individuals with a family history of the disease than in those without 1 (OR=2.08; 95% CI=1.34 to 3.22; p<0.001).[8] Compared to non-obese individuals, obesity increased GDM incidence 1.81 times (p<0.001).

In the present study, 25% GDM cases were primigravidas while 75% were multigravidas. According to a study by Moon women who are multiparous have an increased risk of developing GDM because multiparity increases cellular stress and speeds up the aging process of the pancreatic beta cells, which makes it more difficult for the body to correct for insulin resistance.[9]

In this study, majority of cases and controls (58.5% cases vs 70% controls) delivered at term (≥37 weeks) with LSCS (cases vs controls 53% vs 49.5%) being the most common mode of delivery. Higher rate of LSCS was seen among non GDM controls since the institute in which study is conducted is a referral centre for 6 districts with much higher referral load of high risk patients compared to booked patients. Thus, mode of delivery was not different in two groups. However, in study conducted by Dudhwadkar et al mode of delivery in GDM cases was as follows LSCS -52%, vaginal-46%, vacuum-2%.[11] While in a similar study conducted by Pandey et al (2016), LSCS as a mode of delivery was seen in 64.62% and vaginal delivery -35.38%.[12]

Diabetes in pregnancy is commonly associated with hypertensive disorders of pregnancy. Oxidative stress levels are elevated in pregnant women with diabetes due to maternal adaptation in insulin sensitivity. The shared cause of pregnancy-related hypertension problems and diabetes is oxidative stress and inflammation. In the end, this leads to poor placentation and endothelial dysfunction, which in turn causes gestational hypertension, preeclampsia and HELLP syndrome.[13,14] Thus poorly controlled diabetes in 1st trimester can lead to HDP and subsequently IUGR independently. Our study showed significant association of GDM with HDP (17.5%cases versus 8% controls; p=0.004). This is in concordance with studies conducted by Dahiya et al which found 14.3% GDM cases associated with HDP.[15] Similar study conducted by Dudhwadkar and Fonseca found 26% GDM cases associated with HDP.[11]

Our study showed significant association between preterm labour and GDM (40.5% GDM cases vs 29.5% non GDM controls; p=0.0001). In concordance with present study, studies conducted by Khan et al, Sweeting et al also showed significant association between preterm labour and GDM.[16,17] Possible reason for association of GDM and preterm labour is higher incidence of GDM with polyhydroamnios and infections which are independent risk factors for Preterm labour.

Hyperglycaemia in mother results in hyperglycaemia in foetus which results in fetal polyuria, macrosomia, large placenta, also increased glucose in amniotic fluid promotes increased osmosis which ultimately result in polyhydroamnios. Our study showed significant association of polyhydroamnios and GDM (19.5% GDM cases versus 1.5% non GDM controls; p=0.0001). Various studies have shown association of polyhydroamnios and GDM-Dahiya et al-17.1%, Dudhwadkar and Fonseca-20%, Makwana et al-27.2%.[11,15,18]

The present study showed no significant association between PPH (5% GDM cases vs 4.5% in non GDM controls; p=0.814) and GDM. In concordance with this study, study conducted by Dudhwadkar AR and Fonseca also showed PPH associated with GDM in 6% cases only.[11] In discordance with my study, studies conducted by Lucas et al and Muche et al showed significant association between PPH and GDM.[19,20] GDM is frequently associated with polyhydroamnios (19.5% in present study); macrosomia (2.5% cases in this study), prolonged labour (13% cases in this study); HDP (17.5% cases in this study) all contribute to increased risk for PPH. But these factors were present independently in controls also: polyhydroamnios (1.5% controls in present study); macrosomia (0.5% controls in this study), prolonged labour (10.5% controls in this study); HDP (8.0% controls in this study) hence no significant association between PPH in GDM vs non GDM patients was seen.

This study showed no significant association between GDM and certain maternal complications like prolonged labour, postpartum pyrexia, puerperal sepsis. This is in similarity with study conducted by Kumari et al.[10]

The present study shows significant association between surgical site infection as (11% GDM cases vs 2% non

GDM controls). In concordance with present study, study conducted by Dudhwadkar AR and Fonseca also showed significant relation between GDM and surgical site infection.[11] GDM impairs wound healing due to hyperglycaemia resulting in immune pathway dysfunction and thus causing immunosuppression.

GDM predisposes to UTI due to impaired immune function and also due to glycosuria. This study showed significant association between GDM and UTI (24% in GDM cases vs 6% non GDM controls, p=0.0001). In similarity with present study, study conducted by AI-Bash et al showed significant association between GDM and UTI.[21]

Complications noted in neonates born to mothers with GDM included hypoglycaemia, increased NICU admission, IUD, APGAR <7 at birth, sepsis, hyperbilirubinemia.

Foetuses of GDM mothers are exposed to hyperglycaemia in utero resulting in hyperplasia of fetal pancreatic beta islet cells, which in turn results in hyperinsulinemia leading to hypoglycaemia in neonate. This study showed significant association between GDM and hypoglycaemia in neonate (37.5% GDM cases vs 1% non GDM controls). Similar observations were made by Gajjar et al, Hod et al and Makwana et al in their studies showing association between GDM and hypoglycaemia in neonates.[18,22,23]

Neonates born to GDM mothers are more prone to develop macrosomia (2.5% GDM foetuses of GDM mothers are exposed to hyperglycaemia in utero resulting in hyperplasia of fetal pancreatic beta islet cells, which in turn results in hyperinsulinemia leading to hypoglycaemia in neonate. This study showed significant association between GDM and hypoglycaemia in neonate (37.5% GDM cases vs 1% non GDM controls). Similar observations were made by Gajjar et al, Hod et al and Makwana et al in their studies.[18,22,23]

Neonates born to GDM mothers are more prone to develop macrosomia (2.5% GDM cases vs 0.5% non GDM controls) as explained by pederson's hypothesis. This is in similarity with studies conducted by Dahiya et al and Makwana et al.[15,18]

Our study showed birth weight of neonates as follows <2.5 kg-33% GDM cases vs 30.5% non GDM controls, 2.5-3.99 kg-64.5% GDM cases vs 69% GDM controls, ≥4 kg -2.5% GDM cases vs 0.5% GDM controls. This is in similar to study done by Makwana et al.[18] Birth weight <2.5 kg is seen due to associated complications like HDP, preterm labour.

Certain other metabolic complications are more prevalent in infants of GDM mother’s vs non GDM mothers like respiratory distress syndrome (6% GDM cases vs 2.5% non GDM controls), sepsis (12% cases vs 5.5% non GDM controls), hyperbilirubinemia (8% GDM cases vs 6% non GDM controls), APGAR <7 (6.5% GDM cases vs 4% non GDM controls), IUD (7% GDM cases vs 4% non GDM controls). This is similar to studies conducted by Dahiya et al and Makwana et al.[15,18]

Due to aforementioned complications, GDM neonates have higher rate of NICU admissions (21% GDM cases vs 7.5% non GDM controls). This is in accordance with studies conducted by Sweeting et al and Dahiya et al.[15,17]

Strengths

It was done using DIPSI which could be done irrespective of fasting status, there was minimum loss to follow up. Since the study was done in tertiary care institute with high patient load, screening could be done in a large number of people with higher sample.

Limitations

Since majority of patients were referred, they could not be followed up after delivery for repeat OGTT at 6 weeks. Thus, it could not be made out that they suffered from GDM or pre-existing Diabetes mellitus. Also, since majority of patients referred are high risk with associated co morbidities, true incidence of GDM and associated maternal and fetal complications in general public could not be evaluated.

CONCLUSION

With rising prevalence of GDM, in country like India with majority of people residing in rural areas with minimum access to health services, DIPSI is simple, convenient (done irrespective of fasting status), economic for universal screening and diagnosis of GDM. Obesity and family history of GDM are important risk factors for GDM. Early diagnosis and timely management can help in adequate glycaemic control in antenatal period thus reducing maternal and neonatal morbidity and mortality.

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