Original Article

Gestational glucose intolerance (GGI) and gestational diabetes mellitus (GDM) among antenatal women attending urban community health centers of Lucknow: A cross-sectional study

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Abstract

Background: Gestational diabetes mellitus (GDM) is an emerging public health concern in India, which has detrimental effects on both the mother and the baby. The data on prevalence of GDM was unavailable at secondary urban health facilities, from where a majority of pregnant women seek antenatal services, and the following study identifies this burden. **Methods:** A cross-sectional study was conducted from May 2019 to June 2020 among pregnant women attending the antenatal outpatient department (OPD) at secondary level health facilities in urban Lucknow. A semi-structured interview schedule was administered to the study subjects for collecting the relevant information and 75 g of oral glucose tolerance test was performed irrespective of the meal. The cut-off points taken for the diagnosis of GDM and gestational glucose intolerance (GGI) was as per the guidelines of the Ministry of Health and Family Welfare for diagnosis of GGI/GDM. **Results:** The overall prevalence of GDM and GGI in the study was 11.6% and 16.8%, respectively. Three-fourth of the women (22/29) were diagnosed with GDM in the second trimester of pregnancy. The prevalence of GDM (16.7%) was significantly higher in pregnant women aged more than 25 years and in those who were overweight. Mean birth weight (3.2 ± 8.1 kg) of the babies was significantly higher in the women with GDM. Among the fetal complications was respiratory distress observed among 28 pregnant women and 31% of them had GDM and this was statistically significant. **Conclusion:** The prevalence of GGI and GDM was found 16.8% and 11.6%, respectively. Gestational age, pre-pregnancy weight, pre-pregnancy BMI, weight gain during the pregnancy, family history of diabetes. PCOS, macrosomia and GDM in prior pregnancies was found to significant with GDM in the study.

Keywords: Antenatal, community health centres, gestational diabetes mellitus, gestational glucose intolerance, pregnant women

Introduction

Gestational diabetes mellitus (GDM) is an emerging public health concern in India that affects approximately five million women each year. Existing literature indicate that prediabetes and diabetes affect approximately six million births in India alone, of which

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90% are due to GDM.[1] The prevalence of GDM in India is estimated to be 17.8% in urban, 13.8% in semi-urban, and 9.9% in rural south Indian, and 13.9% among north Indian women.[2,3]

Gestational diabetes can cause adverse health outcomes both in the mother as well as the child. Hypoglycaemia, macrosomia, congenital anomaly, respiratory failure, polycythaemia, birth injury, and hypocalcaemia are the unfavourable health outcomes in the child while the maternal complications include pregnancy-induced hypertension, polyhydramnios, obstructed childbirth, infections (vaginal candidiasis, urinary tract infection), and a high risk of type 2 diabetes mellitus later in pregnancy.[4] However, early detection of glucose intolerance can promote timely introduction of appropriate interventions which will be beneficial both for the mother and the child.

Despite the government of India's (GOI) prior mandate to screen all Indian pregnant women for GDM as a part of routine antenatal package according to the country's 2014 national guidelines, its real operationalisation at primary and secondary healthcare levels is poor, and thus evidence is limited or unavailable at this level of healthcare, especially in Uttar Pradesh.[5] Our study unravels the burden of GDM at secondary health facilities catering to the underprivileged section of the community who have limited access to health services at the tertiary level and seek care for antenatal services majorly from primary and secondary health centres. Very few studies have estimated gestational glucose intolerance (GGI), so our study has put an effort in assessing GGI to get a better understanding of the prevalence of the disease and associated risk factors at the grassroots level.

Thus, the objective of the study was to estimate the prevalence of GGI, GDM, and its risk factors among antenatal women attending the urban community health centres (UCHCs) of Lucknow and its effect on maternal and foetal health outcomes.

Methodology

Study design and setting

This cross-sectional study was conducted from May 2019 to June 2020 among pregnant women attending the antenatal outpatient department (OPD) at secondary-level health facilities in urban Lucknow.

Inclusion criteria

Pregnant women of gestational age less than 34 weeks and resident of Lucknow city who were visiting the antenatal clinic of the selected community health centres of urban Lucknow were included. Gestational age only up to 34 completed weeks was taken, as the insulin resistance increases in the third trimester and it is defined as the sole cause of hyperglycaemia.

Exclusion criteria

All those having history of chronic illness such as hypertension, cardiac disorder, respiratory problem, hepatic disease or taking any regular medication such as corticosteroids, etc. were excluded. These conditions and drugs might alter their blood glucose level. A pre-diagnosed case of type 2 and type 1 diabetes mellitus, women who did not give their consent for oral glucose tolerance test (OGTT), or those unwilling to participate in the study were excluded from the study.

Sample size

The sample size was estimated by using the formula $n = Z^2_{(1-\alpha/2)} *p*q/d^2$, considering prevalence of GDM in India to be 19.8%.[3] A sample size of 250 was calculated by taking 5% allowable error and 95% confidence interval (CI).

Sampling technique

Out of nine community health centres, three UCHCs were purposively selected for the study as supply of 75 g of glucose was available at these centres. To ensure equal enrolment from all the selected centres, 83 antenatal women were enrolled from each selected centre. All pregnant women attending the selected UCHC for antenatal check-up were considered for the study as per inclusion and exclusion criteria. Systematic random sampling method was used for recruiting the study participants.

Ethical clearance

The institutional ethical committee (IEC) of the government medical university, Lucknow, gave its clearance to the submitted research proposal (No: 97th ECM II B-Thesis/P128). Permission from the medical superintendent of the three selected UCHCs was also obtained to conduct the study.

Data Collection

All study participants were explained about the purpose and procedure of the study and those who gave written consent for blood test were enrolled in said study. A predesigned, pretested, semi-structured interview schedule was administered to the study subjects. Information was collected on sociodemographic data of pregnant women like age, caste, religion, education, socioeconomic status, etc. followed by relevant obstetric history including findings like gravida, gestation, and previous history of GDM. Then medical history and family history related to diabetes was also taken.

After filling the questionnaire, 75g of oral glucose was given to the pregnant woman without regard to the last meal. The glucose powder was mixed with 250-300 ml of water and was to be consumed within 5-10 minutes. Two hours after the glucose load, the capillary blood sample was taken by pricking the finger with lancet, and the blood glucose level was measured on the spot using a glucometer. The results of the blood glucose level were recorded and communicated to the woman. If required, the pregnant woman was referred to an obstetrician and physician for further management. If the test result was normal at this time, then participants were asked to repeat the test between 24 and 28 weeks of gestation period once again. The cut-off points taken for the diagnosis of GDM and GGI were as per the 2014 guidelines of the Ministry of Health and Family Welfare for diagnosis of GGI/GDM.[6]

Measurement of blood glucose levels

As per the national guidelines for diagnosis and management of GDM, all pregnant women should be tested as early as possible in pregnancy. The second testing should be done during 24–28 weeks of pregnancy, if the first test is negative. The test should be conducted for all pregnant women even if she comes late in pregnancy for ANC. The Single Step Procedure recommended by the World Health Organisation (WHO) for screening and diagnosis of GDM by 2 hr 75 gm post blood glucose >140 mg/dl was used in the study.[7]

Diagnosis*	Value of plasma glucose after 2 h 75 OGTT
Normal	<120 mg/dl
GGI	120–139 mg/dl
GDM	≥140 mg/dl

*Ministry of Health and Family Welfare for diagnosis of GGI/GDM (2014)

Data analysis

The data was analysed using the Statistical Package for the Social Sciences (SPSS) IBM version 23.0. A descriptive summary using frequencies, percentages, graphs, and cross tabs were used to present the study results. Two-tailed probability (*P*) was calculated to test statistical significance at the 5% level of significance. Association between predictors (risk factors) and outcome variables (GDM and no GDM) was determined using the Chi-squared test.

Results

Sociodemographic characteristics of study participants

A total of 250 pregnant women participated in the study. More than half of the women (59.2%) were less than 25 years of age. The mean age of the participants was 25.2 (4.1) years. The majority of women (67%) were Hindu, followed by 29.2% of Muslims. Twenty-four point four percent had completed primary school education, 25.6% were post-graduates, and the majority (48.4%) had completed their middle school/high school/intermediate level education. Most of the women (69.8%) belonged to the lower-middle class (35.2%) or middle class (33.6%). Only 6% of women were from the upper class. Almost all women (98%) were homemakers.

Prevalence of GDM and GGI

The overall prevalence of GDM in the study was 11.6% and the prevalence of GGI was 16.8% [Figure 1]. Three-fourth of the women (22/29) were diagnosed with GDM in the second trimester of pregnancy. About one-third of women (13/86) who had GGI were diagnosed in the first trimester of the pregnancy [Figure 2].

Risk factors for GDM

No significant different was observed between the mean age of women with GDM and without GDM. The prevalence of GDM (16.7%) was statistically significantly higher in women aged more than 25 years. Prevalence of GDM was higher among women belonging to the upper or upper-middle socioeconomic group. However, socioeconomic status was not found to be statistically associated with the prevalence of GDM [Table 1].

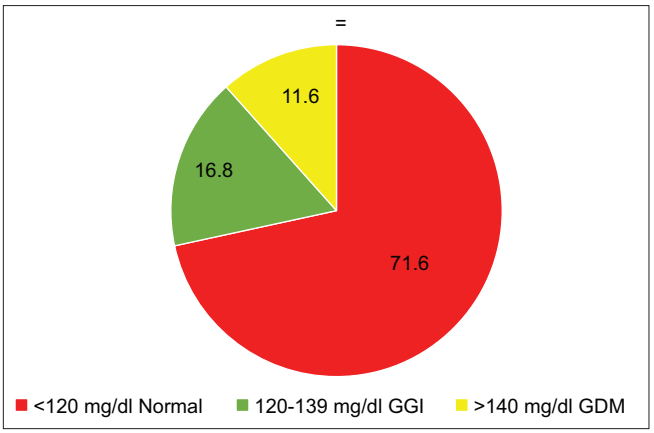

Figure 1: Prevalence of GGI and GDM among the study participants

Out of the overweight pregnant women, almost one-fourth (22.6%) had GDM and this association was statistically significant. Among the 33 pregnant women who gave history of diabetes in a first degree relative, almost 30.3% had developed GDM during pregnancy. The other significant risk factors for GDM were history of infertility or irregular menstrual cycles and history of macrosomia or GDM in prior pregnancies [Table 2].

Pregnancy outcome and maternal complications among women with GDM vs without GDM

Women with GDM delivered babies with higher birth weight. Mean birth weight (3.2 ± 8.1 kg) of the babies was significantly higher in women with GDM in comparison to the mean birth weight (2.7 ± 0.44 kg) of the non-GDM group. One-fourth of the babies were born with birth weight more than 4 kg in mothers diagnosed with GDM. No significant difference was observed in the duration of the pregnancy. Significant maternal complications like pregnancy-induced hypertension (PIH), obstructed labour, perinatal asphyxia, and polyhydramnios was observed among the pregnant women with GDM [Table 3].

Foetal outcome in pregnancies with GDM vs without GDM

Among the foetal complications was respiratory distress observed among 28 pregnant women and 31% of them had GDM and this was statistically significant ($P = 0.003$). Two newborn babies had hypoglycaemia at birth and their mothers had GDM and this was significant ($P = -0.001$). Other significant foetal complications were physiological jaundice ($P = 0.015$) and congenital anomaly ($P = 0.014$) [Figure 3].

Discussion

Gestational diabetes is an emerging silent precursor of poor maternal and foetal health outcomes, and a timely diagnosis and management can be very beneficial for both.

Table 1: Sociodemographic factors associated with GDM and without GDM

Sociodemographic Profile	GDM Present (*n*=29)	GDM Absent (*n*=221)	Total (*n*=250)	χ^2	*P*
Age (years)					
≤25	12 (8.1)	136 (91.9)	148 (59.2)	4.31	0.038
>25	17 (16.7)	85 (83.3)	102 (40.8)		
Mean age±SD	27.1±4.8	25.0±4.0	25.2±4.1		
Religion					
Hindu	17 (10.1)	151 (89.9)	168 (67.2)	1.09	0.295
Non- Hindu	12 (14.6)	70 (85.9)	82 (32.8)		
Education level					
Intermediate and above	14 (14.0)	86 (86.0)	100 (40.0)	0.48	0.606
High school	9 (10.6)	76 (89.4)	85 (34.0)		
Primary school	6 (9.2)	59 (90.8)	65 (26.0)		
Occupation					
Homemaker	28 (11.4)	217 (80)	245 (98.0)	0.35	0.554
Working outside	1 (20)	4 (80)	5 (2.0)		
Socioeconomic class					
Upper/Upper-middle	11 (17.2)	53 (82.8)	64 (25.6)	2.89	0.236
Middle class	7 (8.3)	77 (91.7)	84 (33.6)		
Lower-middle/Lower	11 (10.8)	91 (89.2)	102 (40.8)		

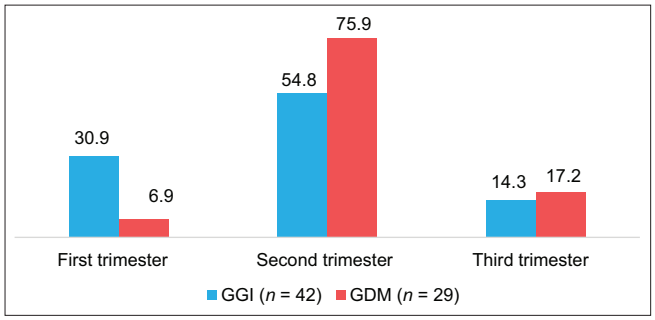

Figure 2: Gestational age of the women at the time of diagnosis of GDM and GGI (N = 250)

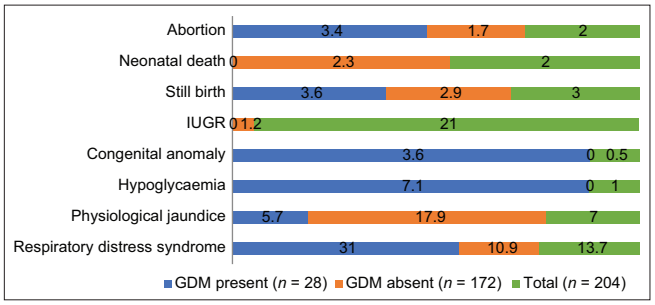

Figure 3: Foetal outcome in pregnancies with GDM vs without GDM

Prevalence of GDM and GGI

In the present study conducted at UCHCs of Lucknow, the prevalence of GDM and GGI was 11.6% and 16.8%, respectively. Agrawal *et al.*,[3] in their study at a tertiary care facility in Lucknow, had reported the prevalence of GDM and GGI as 13.6% and 19.8%, respectively. This higher prevalence in their study was because the majority of the women with high-risk pregnancies or mothers referred from the peripheral health centres sought medical care at the tertiary care facility. However, a systematic review of studies from 20 Asian countries reported a similar prevalence of GDM in hospital (12.1%) and community settings (11.1%).[8]

Risk factors of GDM

Our study observed that maternal age ≥25 years was a precursor to risk of GDM as significant association was observed between advancing maternal age and high prevalence of GDM. Researchers in north India as well as in south India have found similar prevalence of GDM with advancing age.[9–12] High pre pregnancy BMI of the mother was also an established risk factor for GDM. Lee *et al.*[8] found in the systematic review of 20 Asian countries that prevalence of GDM was highest among Asian women with BMI ≥30 kg/m^2 (13.8%) followed by women with BMI ≥25 kg/m^2 (10.2%). The result of our study was in accordance with that of Seshiah *et al.*[13] who reported significantly higher prevalence of GDM at higher BMIs and urban environments.

A majority of the studies observed an association between advance maternal age and obesity with higher risk of GDM. Stewart *et al.*[14] observed that obesity in pregnancy could increase inflammatory status and that inflammation was related to advanced maternal age, which is an important risk factor for GDM. Previous studies also showed that glucose tolerance impaired with age and that obesity was associated with insulin resistance and receptor abnormalities. Moreover, increased demands on maternal metabolism during pregnancy from excess weight gain results in imbalances in hormonal carbohydrate regulation mechanisms and insulin sensitivity. Development of insulin resistance with age may be a consequence of obesity. Older women with obesity may therefore be more prone to developing GDM. Hence, studies are projecting that maternal age, obesity, and GDM are interrelated.[14–17] This fact, in turn, explains the significant association between irregular mensural

Table 2: Risk factors associated with GDM and without GDM

Factors	GDM Present (*n*=29)	GDM Absent (*n*=221)	Total (*n*=250)	χ^2	*P*
Pre-pregnancy BMI (kg/m^2)					
Underweight	3 (4.7)	61 (95.3)	64 (25.6)	29.81	0.001
Normal	15 (10.0)	135 (90.0)	150 (60.0)		
Overweight	7 (22.6)	24 (77.6)	31 (12.4)		
Obese	4 (80.0)	1 (20.0)	5 (2.0)		
Mean BMI±SD	24.4±5.5	20.6±3.2	-		
Height (cm)					
<153	13 (9.3)	127 (90.7)	140 (56.0)	1.66	0.197
>154	16 (14.5)	94 (85.5)	110 (44.0)		
Mean Height±SD	154.14±5.2	152.25±5.4	152.4±5.4		
Gravida					
Primigravida	11 (9.8)	101 (90.2)	112 (44.8)	1.49	0.473
Multigravida	18 (13.0)	120 (87.0)	138 (55.2)		
H/O Infertility treatment					
Yes	6 (28.6)	15 (71.4)	21 (8.4)	6.43	0.011
No	23 (10.0)	206 (90.0)	229 (91.6)		
Diabetes in first degree relative					
Present	10 (30.3)	23 (69.7)	33 (13.2)	13.08	0.001
Absent	19 (8.7)	198 (91.2)	217 (86.8)		
H/O irregular mensural cycle					
Yes	3 (37.5)	5 (62.5)	8 (3.2)	5.40	0.020
No	26 (10.7)	216 (89.3)	242 (96.8)		
Haemoglobin level in index pregnancy					
Normal	5 (17.2)	17 (7.7)	22 (8.8)	4.54	0.104
Mild anaemia	23 (11.5)	176 (88.4)	199 (79.6)		
Mod. anaemia	1 (3.4)	28 (12.7)	29 (11.6)		
Mean Hb±SD	10.2±0.81	9.8±0.91	-		
Tobacco addiction					
Present	2 (6.9)	17 (7.7)	19 (7.6)	0.023	0.879
Absent	27 (93.1)	204 (92.3)	231 (92.4)		
H/O macrosomia in prior pregnancies (*n*=138)					
Present	3 (100)	0	3 (2.2)	20.4	0.001
Absent	15 (12.4)	120 (88.8)	135 (97.8)		
H/O GDM in prior pregnancies (*n*=138)					
Present	5 (71.4)	2 (28.6)	7 (5.1)	22.32	0.001
Absent	13 (9.9)	118 (90.0)	131 (94.9)		
H/O spontaneous abortions in prior pregnancies (*n*=132)					
Present	1 (10.4)	5 (83.3)	6 (4.3)	0.41	0.518
Absent	17 (12.9)	115 (87.1)	132 (95.7)		
H/O preterm delivery in prior pregnancies (*n*=138)					
Present	3 (27.7)	8 (72.7)	11 (8.1)	0.07	0.788
Absent	15 (11.8)	112 (88.1)	127 (92.0)		

cycle (due to PCOS) and GDM which was in accordance with various other researchers who found similar association between the two parameters.[18-22] Again, this was attributed to the increased insulin resistance observed in polycystic ovarian syndrome (PCOS).

Our study showed a significant association between GDM and history of taking infertility treatment. This result agreed with that of Tobias *et al.*[18] and Wang *et al.*,[23] both of who also observed a similar association. However, the underlying reasons for infertility may vary in their associations with risk of GDM and should be evaluated separately. Further research is essential to determine the specific mechanisms responsible for it, with inflammation and insulin resistance playing a pivotal role in the aetiologies of both the conditions.[17]

Maternal and foetal health outcomes in women with GDM vs without GDM

Our study observed that mean birth weight of the babies was significantly associated with GDM. Birth weight was in the range of 2.5–3.9 kg among 48.3%, ≥4 kg in 27.6%, and < 2 kg among 24.1% of mothers. A large proportion of the babies of mothers with GDM had high birth weight. The result of our study was in accordance with Kalyani *et al.*[24] who found a macrosomia rate of 9.33% with 44% of the macrosomic babies

Table 3: Pregnancy outcome and maternal complications among women diagnosed with GDM vs without GDM

Outcome/Complications	GDM Present (*n*=28)	GDM Absent (*n*=172)	Total (*n*=200)	*P*
Pregnancy outcome				
Normal vaginal delivery	7 (24.1)	125 (71.4)	132 (64.7)	0.001
Caesarean section	21 (72.4)	47 (26.9)	68 (33.3)	
Birth weight (kg)	(*n*=28)	(*n*=171)	(*n*=199)	0.0001
<2.5	7 (25.0)	55 (32.2)	62 (31.2)	
2.5-3.0	14 (50.0)	115 (67.3)	129 (64.8)	
>4	7 (25.0)	1 (0.6)	8 (4.0)	
Birth weight (mean±SD)	3.2±0.81	2.7±0.44	2.7±0.54	0.0001
Term at delivery	(*n*=28)	(*n*=172)	(*n*=200)	0.210
Preterm	5 (17.9%)	13 (7.6%)	18 (9.0%)	
Term	22 (78.6%)	152 (88.4%)	174 (87.0%)	
Post-term	1 (3.6%)	7 (4.1%)	8 (4.0%)	
Maternal Complications				
PIH	5/29 (17.2)	7/175 (4.0)	12/204 (5.9)	0.005
Obstructed labour	8 (28.6)	9 (5.2)	17 (8.5)	0.001
Perinatal asphyxia	2 (1.2)	2 (7.1)	4 (2.0)	0.036
Polyhydramnios	6/29 (20.7)	4/175 (2.3)	10/204 (4.9)	0.001
Breech presentation	2/28 (3.5)	6/172 (7.1)	8/200 (4.0)	0.360

born to GDM mothers. Kalra *et al.*[25] demonstrated that among GDM group, 18.1% of the newborns were macrosomic. It has already been well documented that maternal obesity has a strong and independent effect on foetal macrosomia, irrespective of maternal hyperglycaemia.[26]

The most common maternal complication observed in women with GDM were obstructed labour, polyhydramnios, PIH, perinatal asphyxia, and breech presentation. The foetal complications include respiratory distress syndrome, hypoglycaemia, physiological jaundice, congenital anomaly, and intrauterine growth restriction (IUGR). To avoid these adverse foeto-maternal outcomes, elective caesarean section was the most common mode of delivery in the GDM mothers. This further explains the finding in the present study that a majority of the women with GDM underwent caesarean section. The difference between mode of delivery and GDM status was found to be very highly significant. The result of our study was in accordance with a study done in Wardha district in 2013 that found that 56% of participants diagnosed to have GDM underwent lower segment caesarean section.[27]

Strengths and Limitations

The strength of the study is that it gives useful insights into the current burden of GGI and GDM among women seeking care from the peripheral urban health system. The high burden of GDM and GGI among the women seeking antenatal services from secondary health facilities indicate that it is necessary to screen all pregnant women seeking ANC care at these centres with special focus on those with associated risk factors so that they can be adequately and effectively managed.

The study has few limitations. Pre-pregnancy weight was not known by most of participants. For pre-pregnancy body weight calculation, the body weight at the first trimester was noted in all study participants. We considered the average weight gain during the first trimester to be 1.5–2 kg. We subtracted 1.5 kg from the weight taken during their first antenatal visit. Almost all participants visited in the mid of their first trimester. Foeto-maternal outcome was taken on telephone number provided during the interview due to the coronavirus disease 2019 (COVID-19) pandemic starting during that time. This could have led to inadequate information.

Conclusion

The prevalence of GGI and GDM was found to be 16.8% and 11.6%, respectively in antenatal women. Gestational age, pre-pregnancy weight, pre-pregnancy BMI, weight gain during pregnancy, family history of diabetes. PCOS, macrosomia, and GDM in prior pregnancies was found to significant with GDM in the study. Maternal complication like caesarean section, obstructed labour and polyhydramnios was found to be significant with GDM. Foetal complications like macrosomia, respiratory distress syndrome, physiological jaundice, and hypoglycaemia was found to be significant with GDM.

The government should strengthen the diagnosis and management of GDM at the secondary level of care, and awareness should be raised among pregnant women for the same. The community health workers should be trained in understanding GDM and counselling mothers regarding their diet and nutrition. There should be integration of GDM screening along with other diseases in the non-communicable disease (NCD) clinics at the secondary health facilities.

Key take-home message

The high burden of GDM and GGI among women seeking antenatal services at secondary health facilities indicate that it is necessary to screen all pregnant women attending these

centres for antenatal services with special focus on those with associated risk factors for GDM so that they can be adequately and effectively managed at this level of health care itself without any adverse foeto-maternal outcomes.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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