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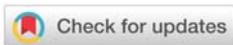
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**Research Article**

# A Prospective study on Impact of Gestational Diabetes Mellitus (GDM) Management on Burden of Diabetes mellitus (DM) in Uttar Pradesh India

**Abstract**

Gestational diabetes mellitus (GDM) is a type of glucose intolerance which is often identified first time in pregnancy. It is important to assess whether in Uttar Pradesh (a largest state of India with one of the highest rate of the infant and maternal mortality rate has also higher chances of future Diabetes Mellitus (FDM) in mothers which may attribute it to GDM uncontrolled in pregnancy. The Primary objective of this study was to be determine whether the future Diabetes Mellitus in women is associated with GDM degree of control and can the GDM Management in Pregnancy Improves future Diabetes Mellitus via a Prospective study approach. A prospective cohort study was done for 2 and half years from October 1, 2016, to March 31, 2019, at 900 GDM screening units as a part of the Gestational Diabetes Prevention and Control Project, Uttar Pradesh approved by the Indian Government in the state of Uttar Pradesh, India. A total of 515532 pregnant women were screened during their 16–32th weeks of pregnancy by impaired oral glucose test (OGTT) as per NHM Guidelines for GDM, 12784 GDM & 7287 Non GDM for maternal and perinatal outcomes were followed up in both GDM and non GDM categories in the 2 years and 6 months (2016-2019) after blood sugar management. The Pregnant women were recruited at 900 healthcare facilities, 515532 Pregnant Women have been screened at 16-20 Weeks & 24th-28 weeks of pregnancy as per Guidelines of National health Mission, GOI Guideline. There were not only Significant(  $p < 0.0001$ ) Perinatal deaths(597)4.6% in GDM category as compared to Non GDM category139(1.9%). There were also more future Diabetics in women in GDM cases, with High Birth weight Babies specially in less Control of Blood Sugar levels during Pregnancy. The Overall incidence of future Diabetes in women cases were only 15.9% in GDM Cases at 140-160 mg/dl at GDM Diagnosis, but as the blood sugar levels increased the Incidence of future diabetes in women increased to high level[>160-200mg/dl (36%)]. So there was a significant association between GDM in Mothers and women developing Diabetes after delivery early with poor perinatal & neonatal outcomes, which suggests GDM Management is Crucial in pregnancy for reducing burden of prospective diabetes in Indian women.

**Introduction**

Diabetes is a growing challenge in India with estimated 8.7% diabetic population in the age group of 20 and 70 years. According to WHO—there is a rising prevalence of diabetes in women and Gestational diabetes Mellitus( GDM—A hyperglycaemia that is first recognized during pregnancy) can be a contributor for this [1]. The literature reveals that with the increase in diabetes prevalence, there is also an increasing prevalence of gestational diabetes mellitus (GDM) [2]. Compared to European women, the prevalence of gestational diabetes in India has increased 11-fold in women [3]. According to USV's 'Take the Power' diabetes awareness survey, there's a

paradox prevailing in India about women diabetics i.e. although awareness about diabetes among women has been high, but the behaviour to prevent it has not shown a significant change [4].

Many studies have been done in various parts of India on various aspects of gestational diabetes mellitus, like Seshiah et al. in Chennai, Wahi et al. in Jammu, and Gajjar in Baroda, Gujarat [5–7]. However studies show the geographical differences in prevalences of GDM cases from 3.6% in Kashmir to 41% in Lucknow which may be attributed to differences in age and/or socioeconomic status of pregnant women in these regions. Moreover it is estimated that about 4 million women are affected by GDM in India, at any given time point [8–9].

Gestational diabetes mellitus (GDM) is one of the most common medical complications of pregnancy which has serious health implications for both mother and child. [10]. The outcome of pregnancy, in terms of mother as well as baby, worse with GDM.[11] It has also been seen from many studies[11–18], in literature that Suboptimal glycemic control in women with GDM is associated with adverse maternal & neonatal outcomes. Therefore Blood sugar levels can be a indicator of maternal and perinatal morbidity and mortality in GDM cases[12]. Further it is also evident from literature that Women with a history of GDM are at an increased risk of both adverse maternal, perinatal and neonatal outcomes and also there as an increased risk of future diabetes predominantly Type II in mothers as well as their children and therefore there are two generations at risk [13].

So, appropriate diagnosis and management of GDM can improve both maternal and perinatal outcomes. Therefore Careful monitoring of blood glucose levels and initiation of appropriate treatment are essential in the care of women with GDM [14]. Moreover the literature also stresses that large-scale prospective studies are also required to determine early fetal loss rates, correlate metabolic status during organogenesis with outcome, and assess the effect of diabetic control on future Diabetes Mellitus in GDM Mothers as well as on Neonates [19–21]. Moreover Indian women with diabetes also needs to play a ‘caretaker role’ in the family and prioritise the health of others above their own [22]. So a study like ours was much needed to see whether Women with gestational diabetes mellitus (GDM) are really at an increased risk of developing type-2 diabetes mellitus (T2DM) later in life, compared to women without GDM. That’s why this study was done as part of a GDM Project of UP Govt in India.

## Materials and Methods

A prospective cohort study was done for 2 and half years from October 1, 2016, to March 31, 2019 as per the flow chart given, at 900 GDM screening units in 18 districts as a part of the Gestational Diabetes Prevention and Control Project, Uttar Pradesh approved by the Indian Government in the state of Uttar Pradesh, India. Muzaffarnagar medical College from Western UP took part in Designing, Analysis and article writing for this study. A total of 515532 pregnant women were screened during their 16–32th weeks of pregnancy by impaired oral glucose test (OGTT) as per NHM Guidelines for GDM, 12784 GDM & 7287 Non GDM maternal and perinatal outcomes were followed up in both GDM and non GDM categories in the 2 years and 6 months (2016–2019), after blood sugar management (October 2016–March 2019) was executed at 900 healthcare facilities, LBW were defined as per Indian Criteria.

Follow-up of gestational diabetes mellitus cases in post-partum screening

Gestational diabetic women requires follow-up. An OGTT with 75 g oral glucose, using WHO criteria for the non-pregnant population should be performed at 6–8 weeks postpartum. If found normal, glucose tolerance test is repeated after 6 months and every year to determine whether the glucose tolerance has returned to normal or progressed. A considerable proportion of gestational diabetic women may continue to have

1<sup>st</sup> Oct 2016 (900 Screening Units) (N=57018)

GDM Cases=12784

Non GDM cases=7287

Pregnant Women screened=515532

31 March 2019

glucose intolerance. It is important that women with GDM be counselled with regard to their increased risk of developing permanent diabetes. The Type II Diabetes was Diagnosed in Post-Partum women as per WHO Classification of Blood Sugar levels was taken as criteria for diagnosis i.e >200 mg/dl after 75 gm Glucose 2 hour load(OGTT).

## Results

There were more Significant( $p < 0.0001$ ) Perinatal mortality (597) 4.66% in terms of Still birth (3.1%), Neonatal Deaths(1.4%) in GDM category as compared to Non GDM category Perinatal mortality(139) 1.9% , still births (92) 1.26% & neonatal death (47) 0.64% [Table 1].

**Table 1:** Fetal outcomes in Gestational diabetes mellitus (N=12784) versus Non GDM[ N=7287]

Outcomes in neonate	GDM present (n=12784) No (%)	GDM Not -present (n=7287) No (%)	RR	p-value
Stillbirth	406 (3.17)	92(1.26)	2.51	<0.0001
Neonatal Death	191 (1.49)	47 (0.64)	2.32	<0.0001
Total Perinatal mortality	597(4.66)	139(1.9)	2.45	<0.0001

In our present study, there were not only more poor outcomes in neonates with Family H/o of DM, LBW & High Birth weight Babies in GDM cases with No Control of Blood Sugar levels. The future Diabetes in (Post-Partum) women with blood sugar level moderately high category 140–160 mg/dl was 15.9% and it increased to 36% with high GDM blood sugar levels >160 mg/dl to >200mg/dl at diagnosis, Family history 7.9% to 18.9%, LBW infant from 9.9% to 21.9% and >3.5 kg infant(macrosomia) from 7.2% to 16.5% were also raised in Blood sugar level 140–160 mg/dl & >160 to >200 mg/dl respectively [Table 2].

It was also seen that as blood sugar levels Increased the Prevalence of Perinatal Mortality cases increased( after 140mg/dl (4.4%) to above 180 mg /dl (8.9%) & 12% beyond >200 mg/dl. Table 3].

**Table 2:** Future Diabetes in women with Neonatal Outcomes in GDM diagnosis as per GDM Blood Glucose Levels at the Diagnosis.

	Post-2hour-Glucose(OGTT)-75 gm Glucose, Post-Partum Type II diabetes in GDM range 140 mg% to <160 mg/dl in GDM cases ( n=8249).	Post-2hour-Glucose(OGTT)-75 gm Glucose, Post-Partum Type II diabetes in GDM range >160 mg% to >200 mg/dl in GDM cases (n=8249).	RR, CI, P value
Future Type II Diabetes in GDM women(Post-Partum Diabetes)	1319 (15.9 %)	2969(36%)	0.61,0.58-0.64, p<0.0001
Family H/O DM+	651(7.9%)	1559(18.9%)	0.34,0.28-0.41,p <0.0001
LBW Birth wt<2.5 kg	822(9.9%)	1814(21.9%)	0.42,2.0-3.1,p<0.0001
Macrosomia birth wt>3.5 kg	593(7.2%)	1361(16.5%)	0.57,0.46-0.73, p<0.0001

**Table 3:** Prevalence of Perinatal Mortality Cases as a function of blood sugar Levels of GDM Cases at the Diagnosis through DIPSI/NHM Criteria in (mg/dl) value.

Profile of Blood Sugar Levels in GDM Cases ( mg%) at Diagnosis	No of Samples (N=515532)	Perinatal Mortality Cases (n=14169) No (%)
<100	n1=113040	2598 (2.2%)
100-119	n2=279675	6460 (2.3%)
120-139	n3=52348	1832(3.4%)
140-159	n4=35235	1567 (4.4%)
160-179	n5=13659	784(5.74%)
180-199	n6=8560	771 (9.0%)
200 and >200	n7=13015	1571(12.0%)

## Discussion

GDM is merging to be an Important Public health Problem in India. According to Dr VSeshiah in India –an important public health priority in the prevention of diabetes must be directed to address maternal health both during the ante- and post-partum period.[22] An earlier study in Kerala's neighbouring state of Tamil Nadu Women with GDM also points towards GDM patients were at higher risk of developing diabetes later in life. GDM Patients is the ideal group to be targeted for lifestyle modification or pharmacologic intervention in order to delay or postpone the onset of overt diabetes and reduce the Burden of Diabetes Mellitus in India. Nearly 60% of diabetics in India have never been screened or diagnosed due to a lack of awareness, according to a 2012 report published by the Brussels-based International Diabetes Federation, an umbrella organisation of diabetes associations in 160 countries. The study said nearly 63% did not even know the complications that arise from the disease [23].

In our present study, out of 8249 Women who came for post partum screening after 6 weeks of delivery 1319 (16%) were diagnosed as Type II Diabetes in GDM category who were

controlled GDM between 140 mg/dl to 160 mg/dl & 2969 (36%) women were Diagnosed Type II Diabetes who have GDM were controlled with >160 mg/dl to 200 mg/dl. This finding was in unison with many related studies [5-9,11-21], on GDM that Blood sugar level management is important in pregnancy.

The Blood Sugar level at the time of Diagnosis of GDM women is strongly related to Perinatal mortality and increased significantly from 3.4% at 120-139 mg/dl to 12% from 200->200 mg/dl, Perinatal mortality is 2.3% from 100-119 mg/dl at GDM Diagnosis, which signify that Blood sugar level should be controlled to <120 mg/dl through Pregnancy 2 hour Post prandial. This finding was in also similar to many related studies [5-9], on GDM that Blood sugar level management is very important in pregnancy.

In our present study more Significant( p< 0.0001) Perinatal deaths(597) in terms of Still birth(3.1%), Neonatal Deaths(1.4%) in GDM category(597) as compared to Non GDM category 139(1.9%) points towards a existing association between Possible Diabetes in Future Mothers with complications in perinatal and neonatal period & GDM in their Pregnant Mothers. This finding was in line with many studies [11-18], suggesting diabetes in later life with H/o GDM in the Mothers.

Moreover In our present study, there were many Future DM in GDM cases which were associated with Family H/o of DM, IUGR & High Birth weight Babies in GDM cases with No Control of Blood Sugar levels. This finding was in line with many studies [ 5-22], suggesting GDM associating with H/o future DM in the Mothers. The Overall Prevalance of GDM with perinatal mortality cases were only 2.7% in GDM Cases, however it was maximum blood sugar rose above 180mg/dl(20%).It was also seen that as blood sugar levels Increased the Prevalence of Future DM cases increased ( More after 140mg/dl(4.4%) to above 180 mg /dl (8.9%). This finding was in line with many Previous studies on GDM [5-22], suggesting diabetes in later life of Mothers with H/o GDM.

It has been seen that multiple risk factors mainly obesity, FH specifically maternal history of type 2 diabetes and consanguinity play an important role to development of T2DM. To overcome these risk factors, screening of patient's family members is essential to identify in early stage and conquer this disease and improve the quality of life with increases in overall life span of individuals [24]. Moreover North Indian diabetes are plagued with gender bias against females, poor quality of health services, myths, and lack of disease awareness compounded with small number of prevention and awareness programmers that too are immature to counteract the growing pandemic [25]. Gender distribution from community studies in India show conflicting results. While some studies from north India show female predisposition, others from southern India have reported higher prevalence in males [26]. Still others have found no gender difference in prevalence [27]. In a north Indian registry, twice as many as under-30 male diabetics are reported as compared to female diabetics.

In most of the north Indian states, male to female ratio is worse because of female feticide due to centuries-old wish to

have a male child to carry the family's name forward. Because of the social disfavor toward girls, female patients are usually the victims of under reporting, leaving treatment and follow up, and absence of family and social support. Usually diabetes in girls is considered as stigma in the society, and families do not pay attention to their treatment. Besides, females observe religious fasts more frequently as compared to males and remain indoors most of the time, with little or no access to recreational physical activity. Both these factors hinder their diabetic control [28].

Usually, around the 24th week of pregnancy, many women develop diabetes with around 18% showing the prevalence of gestational diabetes [29]. Obese women, women with a family history of diabetes, and women who have had gestational diabetes in a previous pregnancy are at higher risk than other women for developing gestational diabetes. In fact, women who have had gestational diabetes in the past have 20% to 50% increased chances of developing type 2- diabetes further ahead in their life [30]. Therefore It is highly recommended that every pregnant woman should undergo oral glucose tolerance tests to diagnose gestational diabetes. A proper diet, exercise and medication can keep gestational diabetes under control [29-31].

In an another German study- the Gestational diabetes mellitus (GDM) complicated ~4% of pregnancies [32]. GDM substantially increased the risk to develop postpartum diabetes and thus identified a high-risk population for the development of both type 1 and type 2-diabetes. Risk estimates of type 2 diabetes after GDM varied from 17 to 63% within 5-16 years after pregnancy, depending upon the ethnic background of the study population and the detection method for GDM and glucose intolerance[33-35]. Like type 2 diabetes, the incidence of postpartum diabetes is therefore increasing [35]. So our study finally reveals that Diabetes in Postpartum mothers is not only significantly associated with GDM in Mothers but also poor perinatal and neonatal outcomes in GDM mothers so, this finding was in unison with similar kind of studies done nationally and internationally [22-35].

**Limitations of Study:** We cannot surely say that some infant deaths were due to GDM and can future Diabetes in GDM women can cause, infantile diabetes cannot be said conclusively from our research study. There were large no of GDM women who were uncontrolled in their GDM which precipitated Type 2 Diabetes on Post-Partum visit & Subsequent Visit.

## Conclusion

Overall Perinatal & Neonatal morbidity and mortality is significant in pregnant women in GDM with higher chances of growing diabetes in women later in life. There is a significant association between GDM in Mothers and Post-Partum Mothers developing Diabetes early in life which suggests GDM Management is Crucial in pregnancy to prevent future Diabetes Mellitus in both Mother & possibly Children also. How exactly GDM is causing behind this association needs further study in future by genetic and other experimental studies.

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