

## Prevalence of gestational diabetes mellitus and its correlation with blood pressure in Manipuri women

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### ABSTRACT

**Objective:** The aim and objective was to study the prevalence of gestational diabetes mellitus (GDM) by using National Diabetes Data Group (NDDG) and American Diabetes Association (ADA) (2004) criteria and the correlation of GDM with gestational blood pressure (BP) and maternal age. **Study Design:** This was a cross-sectional study in which 300 pregnant women in 24-28 weeks of pregnancy who screened positive with 1-h glucose load  $\geq 140$  mg/dL underwent a diagnostic 3-h oral glucose tolerance test (OGTT). BP was obtained by review of the medical records. **Results:** Thirty-seven (12.33%) women were screened positive with 50 g glucose challenge test (GCT) ( $\geq 140$  mg%) out of the 300 participants. With 100 g 3-h OGTT among these 37 women, none of them fulfilled the NDDG diagnostic criteria for GDM. However, on using the ADA (2004) criteria, three (8.1%) women were diagnosed to have GDM. All three of them had systolic BP between 120 and 139 mmHg; two of them had diastolic BP between 80 and 89 mmHg. Among 37 subjects with GCT  $> 140$  mg%, majority were older than 26 years. **Conclusion:** Using the ADA (2004) guideline, 1% of the total study population had GDM. The BP of these patients fell within the prehypertensive range, thus suggesting an association between GDM and BP.

**Key words:** Blood pressure, gestational diabetes mellitus, glucose tolerance test

### INTRODUCTION

The prevalence of gestational diabetes mellitus (GDM) among pregnant women in the United States ranges from 3% to 7%, depending on the population studied.<sup>[1-3]</sup> Most women with GDM do not continue to have hyperglycemia after delivery.<sup>[4]</sup> However, up to 50% of women with a history of GDM will develop type 2 diabetes in the decade following their GDM diagnosis.<sup>[5]</sup>

Women with both pre-GDM and GDM are at an increased risk for hypertensive disorders of pregnancy and can lead to higher maternal and fetal morbidity. On the reverse, hypertensive disorders of pregnancy can lead to significant increases in the risk for future cardiovascular events in

diabetic women and women with a history of gestational diabetes.<sup>[6]</sup>

Some studies have shown that elevated BP before or during early pregnancy are associated with the development of gestational diabetes. There are no published data on this from North-East. We planned to evaluate the prevalence of GDM and its correlation with maternal age and gestational blood pressure (BP) in a study among women with singleton pregnancy in Manipuri population.

### MATERIALS AND METHODS

#### Study design

This was a cross-sectional study carried out in the Department of Medicine, Regional Institute of Medical Sciences (RIMS), in collaboration with the Department of Obstetrics and Gynaecology, RIMS. The duration of the study is two calendar years from September 2010 to August 2012. Three hundred cases of randomly selected pregnant women from the outpatient unit of the Department of Obstetrics and Gynaecology, RIMS, with spontaneous singleton pregnancy in the 24<sup>th</sup> to 28<sup>th</sup> weeks of gestation having no history of GDM before the index pregnancy

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DOI:  
10.4103/2230-8210.122597

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were made to undergo a detailed clinical examination. Women with a history of GDM in the previous pregnancy, known case of diabetes mellitus and systemic hypertension, and unwilling subjects were excluded from the study.

All the selected participants underwent a glucose challenge test (GCT) where 50 g of glucose was given to them, without considering the timing of the last meal. Cases with blood sugar level  $\geq 140$  mg/dL after 1 h proceeded to 100 g 3-h oral glucose tolerance test (OGTT). A patient is considered to have GDM if two or more of the values obtained during the 100 g glucose load 3-h OGTT are abnormal according to either or both the National Diabetes Data Group (NDDG) criteria<sup>[7]</sup> and American Diabetes Association (ADA) (2004) criteria.<sup>[8]</sup>

Women were categorized according to BP level recommended by American Heart Association, outside of pregnancy, that is,  $< 120/80$  mmHg as normal, 120-139/80-89 mmHg as prehypertension,  $> 140/90$  mmHg as hypertension.<sup>[9]</sup>

Pregnancy BP was the BP measured at 24-28 weeks of gestation and pregravid BP is the BP measured closest to but before last menstrual period and no more than 5 years before pregnancy; not included if it was from an emergency visit.

### Statistical analysis

The data were analyzed using SPSS v. 16 and correlation was done using Fisher's exact test with a confidence interval of 95% and the significance level at  $P < 0.05$ .

## RESULTS

One hundred and thirty-three women out of the 300 (43.3%) have both systolic and diastolic BP in the prehypertensive range of above 120/80 mmHg. One hundred and seventy-nine (59.7%) women have systolic BP in the prehypertensive range of 120-139 mmHg and 191 (63.7%) women have diastolic BP in the prehypertensive range of 80-89 mmHg. The various levels of BP in different age groups are shown in Table 1.

Out of 300 pregnant women screened, 263 (87.67%) had GCT  $< 140$  mg % and 37 (12.33%) subjects had GCT  $> 140$  mg %. The majority of the women with positive screening on 50 g GCT were in the age range 26-30 years [Table 2].

Among these 37 participants screened positive for GCT, there was a statistically significant association with raised systolic BP but similar association was not seen with

diastolic BP. The distribution of BP among women with normal or impaired 50 g GCT is shown in Table 3.

With 100 g 3-h OGTT among the 37 subjects with positive 50 g GCT, the median blood glucose fasting level was  $82 \pm 12.14$  mg%, for 1-h OGTT  $170 \pm 24.3$  mg%, for 2-h OGTT  $132 \pm 17.7$  mg%, and  $104 \pm 15.8$  mg% for 3-h OGTT. None of them fulfilled the NDDG diagnostic criteria of GDM in the 100 g 3-h OGTT, although two patients had fasting blood glucose level above the cutoff level of  $> 105$  mg% [Table 4a].

However, on using the ADA (2004) criteria, among the 37 participants with 50 g GCT level  $> 140$  mg%, three (8.1%) were diagnosed to have GDM with 3-h 100 g OGTT. This represents 8.1% increase in GDM diagnoses, from 0% (0 of 37) to 8.1% (3 of 37), using the more inclusive criteria. The BP of the three GDM patients was 120/88, 128/80, and 130/88 mmHg, which fell within the prehypertensive range [Table 4b].

According to the NDDG criteria with the cutoff point for a positive fasting blood sugar level  $> 105$  mg%, two (5.4%)

**Table 1: Distribution of age and blood pressure during pregnancy**

Age (years)	Systolic blood pressure (mmHg)		Diastolic blood pressure (mmHg)	
	90-119	120-139	70-79	80-89
17-20	32	19	23	27
21-25	65	60	51	72
26-30	20	56	19	52
31-35	4	30	12	32
36-40	0	12	4	8
Total	121	179	109	191

**Table 2: A 50 g glucose challenge test in different age groups**

Age (years)	Blood glucose $< 140$ mg%, n (%)	Blood glucose $> 140$ mg %, n (%)
17-20	48 (18.3)	2 (5.4)
21-25	113 (43)	10 (27)
26-30	54 (20.5)	17 (45.9)
31-35	38 (14.4)	6 (16.2)
36-40	10 (3.8)	2 (5.5)
Total	263 (87.66)	37 (12.33)

**Table 3: Blood pressure and 50 g glucose challenge test**

GCT (mg%)	Systolic blood pressure (mmHg)		P value	Diastolic blood pressure (mmHg)		P value
	90-119	120-139		70-79	80-89	
$< 140$	115	148	0.002	100	163	0.149
$> 140$	6	31		9	28	
Total	121	179		109	191	

GCT: Glucose challenge test

**Table 4 (a): A 100 g 3-h oral glucose tolerance test and blood pressure. National diabetes data group criteria**

Timing	Blood glucose level (mg%)	Systolic blood pressure (mmHg)			Diastolic blood pressure (mmHg)		
		90-119	120-139	P value	70-79	80-89	P value
Fasting	<105	6	29	0.698	9	26	1.000
	>105	0	2		0	2	
At 1 h	<190	6	31	-	9	28	-
	>190	0	0		0	0	
At 2 h	<165	6	31	-	9	28	-
	>165	0	0		0	0	
At 3 h	<145	6	31	-	9	28	-
	>145	0	0		0	0	

**Table 4 (b): A 100 g 3-h oral glucose tolerance test and blood pressure. ADA (2004) criteria**

Timing	Blood glucose level (mg%)	Systolic blood pressure (mmHg)			Diastolic blood pressure (mmHg)		
		90-119	120-139	P value	70-79	80-89	P value
Fasting	<95	6	26	0.566	9	23	0.306
	>95	0	5		0	5	
At 1 h	<180	5	28	0.523	8	25	1.000
	>180	1	3		1	3	
At 2 h	<155	6	28	1.000	8	26	1.000
	>155	0	3		1	2	
At 3 h	<140	6	31	-	9	27	-
	>140	0	1		0	1	

ADA: American diabetes association

participants showed a positive result and both of them had systolic BP within the range 120-139 mmHg and diastolic BP within the range 80-89 mmHg (prehypertensive range). On using the ADA (2004) criteria, five (13.51%) participants showed a positive result at >95 mg% and they all fell in the prehypertensive range of BP, that is, 120-139 mmHg for systolic BP and 80-89 mmHg for diastolic BP.

In the 1 h OGTT, none of the participants reached the cutoff level for positive test, that is, >190 mg% on using the NDDG criteria. But on using the ADA (2004) criteria, four (10.81%) participants have blood sugar level above the cutoff level of >180 mg%. Among these four women, three had a systolic and diastolic BP within the prehypertensive range (120-139 and 80-89 mmHg).

Again in the 2-h OGTT result, none of the participants reached the NDDG cutoff level of blood sugar >165 mg%, whereas on using the ADA criteria, three (8.1%) women had blood sugar level >155 mg%. All three of them had systolic BP between 120 and 139 mmHg; two of them had diastolic BP between 80 and 89 mmHg.

One (2.7%) participant showed a positive 3-h OGTT result of >140 mg% as per the ADA (2004) criteria and her BP fell within the prehypertensive range for both systolic and diastolic pressures. There was no positive result in the 3-h OGTT on using the NDDG criteria.

## DISCUSSION

In Manipuri population, the prevalence of diabetes mellitus has been reported to be 4.03% in 1997<sup>[10]</sup> and the prevalence of gestational diabetes was reported to be 1.6% in 1999.<sup>[11]</sup>

A recent study in a tertiary care institution from North India has also reported a low prevalence (1.5%) of GDM.<sup>[12]</sup> Several studies from various parts of India have reported the prevalence of GDM ranging from 3.8% to 17.8% using different criteria.<sup>[13-18]</sup>

In the present study, out of the 300 participants, 37 women had blood glucose level more than 140 mg% in the 50 g GCT with the majority older than 26 years. There was a significant correlation between screening positive in GCT and age.

The same finding was observed by Seshiah *et al.*<sup>[19]</sup> who mentioned in their study that age >25 years is one of the independent risk factor for GDM. Similarly, Hoseini *et al.*<sup>[20]</sup> have also included maternal age >26 years as one of the significant risk factors for GDM. ADA (2010) guideline also mentioned age <25 years as a low-risk group who do not require screening for GDM unless they have other risk factors for GDM.<sup>[21]</sup>

The distribution of the BP among the participants in relation to positive screening of GCT showed a significant relationship. Although the participants do not have

hypertension, those with positive GCT still have a higher BP range compared with those with negative GCT. Previous other studies have also shown association of BP with impaired GCT. Solomon *et al.*<sup>[22]</sup> observed abnormal glucose loading test as a significant predictor of development of hypertension and nonproteinuric hypertension in pregnancy. Vembergre *et al.*<sup>[23]</sup> also noted that pregnancy-induced hypertension appears to be linked to the level of glucose intolerance during pregnancy, independently of the other known risk factors of hypertension. During early pregnancy, women with prehypertension had a small increased risk of GDM, and women with hypertension had a twofold increased risk of GDM compared with women with normal BP after adjusting for age, race/ethnicity, gestational week of BP, body mass index, and parity. Similar results were seen among the subset of women with BP levels measured before pregnancy.<sup>[24]</sup>

Several randomized clinical trials had compared various standard criteria for screening and diagnosis of GDM, but the opinion about the policy of detection and diagnosis has not been settled. The Fourth International Workshop Conference on GDM indicated that the infants of women who meet the lower Carpenter–Coustan criteria are at similar risk for perinatal morbidity as those patients identified using the NDDG criteria.<sup>[25]</sup>

Thus, using the more inclusive ADA (2004) criteria may help us to identify an additional number of women with GDM who otherwise may have gone undiagnosed and untreated although they have similar risk as that of the treated women.

Mild gestational hyperglycemia (MGH), which is defined as a positive GCT followed by a negative OGTT, is characterized both by insulin resistance and a near-normal pattern of glucose-triggered insulin release.<sup>[26]</sup> Vemberge *et al.*<sup>[23]</sup> defined gestational mild hyperglycemia as one abnormal value of OGTT in their study and showed the rate of pregnancy-induced hypertension in GDM, gestational mild hyperglycemia, and control were, respectively, 17.0%, 10.8%, and 4.6%. Pregnancy-induced hypertension was linked to the level of glucose intolerance during pregnancy, independently of the other known risk factors of hypertension. Gonsalves *et al.*<sup>[27]</sup> had also mentioned that women with gestational hyperglycemia and GDM have higher risk of hypertension in addition to that of type 2 diabetes. Similarly, Retnakaran *et al.*<sup>[28]</sup> have concluded in their study that both GDM and mild glucose intolerance predict an increased likelihood of metabolic syndrome at three months postpartum, supporting the concept that women with gestational dysglycemia may have an underlying latent metabolic syndrome.

On that note, our study has observed 37 participants with abnormal GCT but having normal 3-h OGTT according to the NDDG criteria. Two participants showed an abnormal fasting blood sugar level but their 3-h OGTT remained within the normal limit. These two women may, therefore be labeled as having MGH. Apart from those who met two of the cutoff values in the 3-h OGTT to be diagnosed as GDM as per the ADA (2004) guideline, an additional five women met one of the cutoff values among the three OGTT cutoffs. Three of them had a fasting blood glucose level >95mg% and another two had a 1-h OGTT level >180 mg%.

So, in the present study, out of the 300 women, three were diagnosed with GDM, five women have gestational mild hyperglycemia and 37 women have MGH. Women with gestational diabetes are at an increased risk for hypertensive disorders of pregnancy.

## CONCLUSION

In the present study, three (1%) women were diagnosed with gestational diabetes on using the ADA (2010) criteria. Although none of the women in the study have hypertension, 83.8% of those who screened positive for gestational diabetes have systolic BP in the prehypertensive range; 16.2% of them have diastolic BP in the prehypertensive range showing an association of BP with gestational dysglycemia in Manipuri women.

## LIMITATIONS OF THE STUDY

Because of the small sample size and cross-sectional nature of the study, there is limitation in the interpretation of this study. Also, with 11.33% women detected to have gestational dysglycemia, a larger study with adequate sample size, follow-up, and duration is needed to give us more insight about the prevalence of gestational diabetes and its correlation with BP, its effect on the maternal and fetal outcome, and also the impact of diagnosing and treating the women who were diagnosed only on using the more inclusive criteria.

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**Cite this article as:** Vanlalhruii, Ranabir S, Prasad L, Singh NN, Singh TP. Prevalence of gestational diabetes mellitus and its correlation with blood pressure in Manipuri women. *Indian J Endocr Metab* 2013;17:957-61.

**Source of Support:** Nil, **Conflict of Interest:** None declared.