

Original Research Article

Demographic profile of pregnant women and effect of anaemia in gestational diabetes mellitus: a cross sectional study from rural Assam

Subrata Chanda^{1*}, Amarjeet Singh²

¹Department of Clinical Domain, Piramal Swasthya Management and Research Institute, Guwahati, Assam, India

²Department of Community Medicine and School of Public Health, PGIMER, Chandigarh, India

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*Correspondence:

Dr. Subrata Chanda,

E-mail: dsub05@yahoo.co.in

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ABSTRACT

Background: In Assam, gestational diabetes mellitus (GDM) screening is not routinely done during antenatal check-up in Assam, whereas anemia screening is done. Consequently, state-wide GDM estimate and its association with anemia in rural Assam is not available. Hence, we aim to study the demographic profile of pregnant women and their anaemia in relation to prevalence of gestational diabetes mellitus in rural Assam.

Methods: The present study was part of a larger community based cross-sectional study, conducted in Assam to determine the prevalence of GDM. The pregnant women in the gestational age of 24-28 weeks, who were free of any chronic illnesses, screened for Anaemia and, GDM through oral glucose tolerance test (OGTT) as per diabetes in pregnancy study group in India guideline.

Results: A total of 1212 pregnant women underwent the OGTT and test for haemoglobin estimation. Mean age of GDM women was (24.40±4.60 years), slightly higher than non-GDM women (23.50±4.04 years, p=0.007). After hemoglobin estimation, 83% of pregnant women found to be anaemic, 77% of these were GDM positive, which is quite significant with p value 0.025. A higher fraction of the pregnant mothers in our study were found suffering from anemia (83%). The independent association of GDM and anemia adjusted for other variables showed an inverse relationship.

Conclusions: Though prevalence of anaemia and GDM in low resource setting in rural Assam found to be quite high, but they have inverse relationship. Anaemic pregnant women were found to be GDM protective.

Keywords: Anaemia, Gestational diabetes mellitus, Sociodemographic profile, Relationship

INTRODUCTION

Healthcare delivery in Assam, one of the north-eastern states of India, is a challenge due to the difficult terrain making accessibility and deployment of resources a difficult proposition.¹ This results in poor or non-implementation of different government health schemes such as gestational diabetes mellitus (GDM) screening, which is not a regular part of ante-natal check-ups in Assam, while anaemia screening is in place. In spite of

this, anaemia is a major problem in pregnancy and childhood. According to the National Family Health Survey 4 (NFHS-4), anaemia prevalence in pregnancy is extremely high in India with 50% in 2015-2016 with only 8% reduction from 2005-2006 (NFHS-3).^{2,3} Anaemia during pregnancy is associated with post-partum haemorrhage, neural tube defects, low birth weight, premature births, stillbirths and maternal deaths.⁴ Hence anaemia and GDM screening are important components during antenatal check-ups.

Gestational diabetes mellitus (GDM) is high blood glucose detected for the first time during pregnancy.⁵ The hyperglycaemia in pregnancy and adverse outcomes (HAPO) study highlighted the association between GDM and adverse foetal outcomes.⁶ This is also associated with risk of developing future diabetes mellitus (DM) in mother and foetus (type 2).⁷ Treatment of GDM reduces the risk of perinatal severe complications and prevention of type 2 diabetes.^{6,8,9}

Diabetes affects 8.3% (366 million people) of the world population in 20-79 years age group.^{10,11} Approximately, 80% of these are living in poor and developing countries.¹² Globally, Gestational diabetes mellitus affects approximately 7% of all pregnancies. The prevalence of GDM is high in the Indian population as compared to other Asian countries due to differences in demographic and socioeconomic status of pregnant women in these regions.¹³ In India, GDM prevalence ranges from 6 to 9% in rural and 12 to 21% in urban area.¹⁴

The GDM problem is more acute, particularly in rural area where public health facilities are the only means of seeking preventive care, treatment and support.¹⁵ Moreover, these public health facilities often suffer infrequent glucose and insulin supply leading to delayed or in some cases, mis-diagnosis of GDM among suspected mothers.¹⁶ A few studies with limited samples documented GDM prevalence in resource constraints areas of rural Assam.^{17,18} However, statewide GDM estimates and association with anemia among rural population of Assam is not clear. Hence, we aim to study the demographic profile and anemia in relation to prevalence of gestational diabetes mellitus in rural Assam.

The study was carried out on Sanjeevani Mobile Medical Unit (MMU) program, which is a nurse-led MMU program being implemented by Piramal Swasthya on a Public Private Partnership engagement with National Health Mission, Government of Assam. Under the program, a total of 78 MMUs cover a total of 3744 villages across the state of Assam, that amounts to 14.4% of all villages (26,000). A nurse, a pharmacist, a laboratory technician and a registration and measurement officer (RMO) are parts of the unit. MMUs were utilized in our study due to their good reach to remote areas.

METHODS

Setting

Assam has a challenging topography with a population of 30.12 million an increase from figure of 26.7 million in 2001 census with 993 females per 1000 males.^{2,19} As of 2015-17, Assam has the highest maternal mortality ratio (MMR) in the country at 229 deaths per 100 000 live birth compared to India's MMR of 122.²⁰ Therefore, Assam needs a dual-pronged strategy to tackle infant mortality rate (IMR) which now stands at 44.²¹ Assam has

also increasing trend in non-communicable diseases incidence, especially diabetes and hypertension. As per NFHS-4, high blood sugar detected in 5.2% and 6.6% of women and men respectively and hypertension (grade I) is 11.8% and 15.1 in women and men respectively.² Prevalence of anaemia is also quite high. 44.8% of pregnant women and 46% of non-pregnant are anaemic in Assam.

Study design

The present study was part of a larger community based cross-sectional study, conducted in Assam to determine the prevalence and risk factors of GDM.

Study outcomes

The outcome of this study was defined as distribution of demographic variable such as education, age, BMI, religion, economic status, gravida, including anaemia among GDM positive and negative pregnant women. Association of anaemia with GDM was also studied.

Sampling procedure

The whole study was delivered through the Sanjeevani mobile medical unit (MMU) program. The program, for the purpose of its operations, has divided the state into five zones- East, West, Central, North and South zones. We randomly selected 50% of the MMUs from each zone. Each MMU covers a total of 48 service delivery points (village) every month. For the purpose of this study, we considered the total number of villages (and population) covered by each MMU as a 'cluster' and randomly selected 20 service points per cluster, using a probability proportional to size approach. A total of 39 clusters were thus chosen. Next, we had line listed all pregnant women in the gestational age of 24 to 28 weeks available in all these 39 clusters. Within each cluster, we chose 30 pregnant women, thereby taking the study sample size to 1170. 30 pregnant women is the statistical requirement considering the expected GDM of 7%, with design defect 1.5, and a 95% confidence interval. All random selection of MMUs, villages and pregnant women were done through random number generator from a website, Stat Trek.²²

Figure 1 depicts the flow of sampling strategy.

Inclusion and exclusion criteria

All pregnant women in between a gestational age of 24-28 weeks included. Pregnant women with any chronic illnesses were excluded from the study.

Survey planning and execution

The study followed Diabetes in Pregnancy Study Group in India and government of India guidelines, which advocates diagnosis of GDM through oral glucose

tolerance test (OGTT), irrespective of the fasting status.^{23,24} A blood sugar level of 140 mg/dl (7.8 mmol/l) or higher at 2 hour after ingestion of 75 gm glucose indicate gestational diabetes. First step involved line listing of all 24-28 weeks gestation pregnant women (PW) identified from mother and child protection (MCP) card, who were mobilized by community health worker, known as accredited social health activist (ASHA) to pre-identified primary health care (PHC) or sub centre (as per inclusion and exclusion criteria) where MO was available. The staff at the MMU initiated the data collection with recording information on sociodemographic variables, usage of alcohol, tobacco and utilization of health care services collected. Then measurements of height, weight, and blood pressure taken through the relevant equipment as per WHO STEPS manual.²⁵ Then haemoglobin was estimated using a standard hemoglobinometer. Woman was asked to drink 75 g anhydrous glucose powder dissolved in 300 ml water and consumed over 5 min, counting from the start of the drink. Blood sugar was measured at 2 hours after glucose consumption using a standard glucometer. A vehicle was hired at each PHC to transport all pregnant women to and from their homes.

Data collection and statistical analysis

MMU staff collected data from July-Sept 2019 using a specific survey tool. Primary data entered in excel and imported into STATA version 15, for further analysis.²⁶ Chi-square test was used to test the difference in proportions. Odds ratios were calculated for different risk factors using bivariate and multiple logistic regression analyses. Categorical data presented as percentages (%) and Pearson's Chi-square test was used to evaluate differences between groups. Multivariate logistic regression (stepwise method) assessed the independent association of anaemia with prevalence of GDM.

RESULTS

After excluding 198 pregnant women, who were suffering from chronic illnesses including diabetes, we found 1212 eligible pregnant women, who underwent the OGTT. The mean age of the 1212 women was 23.70±4.20 years, mean BMI 21.26±3.21 kg/m². Of them 596 were primi gravida and 616 were multigravida. Prevalence of GDM was found to be 16.67% (95% CI=14.61-18.89%) using 2 h OGTT. Mean age of GDM women was (24.40±4.60 years), slightly higher than non-GDM women (23.50±4.04 years, p=0.007).

Table 1: Sociodemographic profile of pregnant women in rural Assam among GDM negative and positive groups

Variable	GDM negative	GDM positive	Total	P value (GDM (-) vs GDM (+))
	N (%)	N (%)	N (%)	
Age (Mean±SD)	23.5(4.04)	24.4 (4.6)	23.7 (4.2)	0.007
Age categories (in years)				
15-20	291 (29)	51 (25)	342 (28)	
21-25	437 (43)	71 (35)	508 (42)	
26-30	235 (23)	63 (31)	298 (25)	
>30	47 (5)	17 (8)	64 (5)	
Religion				
Hindu	566 (56)	102 (51)	668 (55)	0.22
Muslim	433 (43)	99 (49)	532 (44)	
Christian	11 (1)	1 (1)	12 (1)	
Education				
Illiterate	71 (7)	10 (5)	81 (7)	0.35
Primary school	516 (51)	93 (46)	609 (50)	
Matriculation	234 (23)	53 (26)	287 (24)	
Higher secondary	136 (14)	31 (15)	167 (14)	
Graduate and above	53 (5)	15 (7)	68 (6)	
Economic status				
Above poverty line	247 (24)	68 (34)	315 (26)	0.006
Below poverty line	763 (76)	134 (66)	897 (74)	
Body mass index				
Normal	700 (69)	125 (62)	825 (68)	0.06
Underweight	194 (19)	43 (21)	237 (20)	
Overweight or obese	116 (12)	34 (17)	150 (12)	
Gravida status				
Primigravida	499 (49)	97 (48)	596 (49)	0.72
Multigravida	511 (51)	105 (52)	616 (51)	
Total	1010	202	1212	

Table 2: Distribution of Anaemia in GDM negative and positive groups.

Variable	GDM negative	GDM positive	Total
	N (%)	N (%)	N (%)
Non-anaemic	164 (16.24)	46 (22.77)	210 (17.33)
Anaemic	846 (83.76)	156 (77.23)	1,002 (82.67)
Total	1010	202	1212

Pearson chi2 = 5.0180, p=0.025.

Table 3: Distribution of pregnant women by haemoglobin levels in GDM negative and positive groups.

Haemoglobin* (gm/dl)	GDM negative	GDM positive	Total
	N (%)	N (%)	N (%)
Severe anaemia (<7)	7 (0.69)	0	7(0.58)
Moderate anaemia (7-9.9)	552 (54.65)	99 (49)	651(53.71)
Mild anaemia (10-10.9)	273 (27.03)	54 (26.73)	327(26.98)
No anaemia (≥11)	178 (17.62)	49 (24.26)	227(18.73)
Total	1010	202	1212

*As per WHO guideline²⁷

Table 4: Crude and adjusted odds ratios of GDM in relation to anaemia.

Variable	Unadjusted		Adjusted	
	Odds ratio (95% CI)	P value	Odds ratio (95% CI)	P value
Anaemic	1.00		1.00	
Non-Anaemic	1.52 (1.05-2.20)	0.03	1.46 (0.94-2.26)	0.09

Estimates were calculated using logistic regression with a robust cluster estimator of the variance in stata 15.1.

Religion wise there were 55.11% Hindu and 43.90% Muslim with very small proportion of Christian with 1%. Regarding educational qualification, 50% of pregnant women found to be have primary school education, with GDM positivity of 46% among the same group. Body mass index (BMI) calculations found 20% as underweight and 12% as overweight. Significant proportion of GDM positive pregnant women found among age categories ≥26 years (p=0.007), underweight and obese (p=0.06), above poverty line (p=0.006) (Table 1).

We did haemoglobin estimation of all sampled pregnant through digital hemoglobinometer, before doing OGTT. On haemoglobin estimation, 83% of pregnant women found to be anaemic, 77% of these were GDM positive, which is quite significant with p value 0.025 (Table 2).

The Table 3 depicts the distribution of haemoglobin% in different categories. We followed WHO guideline in defining the categories of anaemia. More than 50% of pregnant women were having moderate anaemia, followed by mild anaemia with 26.98% and severe anaemia at 0.58%. Among the GDM positives, highest is moderate anaemia with 49% followed by mild anaemia and normal haemoglobin with 26.73% and 24.26% respectively (Table 3).

Table 4 presents the bivariate and multiple logistic regression analysis to determine the association of anaemia with GDM. Bivariate regression (unadjusted) and

multivariate regression showed non-anaemic (p=0.03), had significant association with GDM.

DISCUSSION

The present study is a part of broader study conducted among pregnant women in low resource setting in rural Assam. The overall prevalence of GDM in our study is 16.7%. However good variation found in Indian studies where studies were conducted in different geographical places of India such as Haryana (7.1%), West Rajasthan (6.6%).^{28,29} The basic characteristics of GDM mothers and non-GDM mothers did not vary significantly except for age, body mass index and economic status. The study sample comprised mainly pregnant young, mostly literate, Hindu and Muslim females which correspond to the latest population statistics of the state.¹⁹

Many studies, have shown that GDM prevalence increases with increasing maternal age.^{14,30,31} In our study, GDM was more frequent among those more than 24 years, while the non-GDM cases had a mean age of 23.5 years. The prevalence of malnutrition (underweight and overweight or obesity) among GDM positive and GDM negative pregnant women were significantly different. 21% and 17% of GDM positive women are underweight and obese respectively. Many national and international studies confirm our findings.^{14,28,32} One study from China has conflict with our findings on BMI, which found no significant association of BMI with GDM.³³ However,

there are no studies which report the linkage of underweight and GDM prevalence. GDM prevalence found to be more in below poverty line category as compared to above poverty line (66% vs 34%). This result found consistent with other studies as well, where low socioeconomic status is considered as major risk factor for the development of type 2 DM.³⁴ We found that women with less education had an increased risk of developing GDM which is in line with Bo et al and Bouthoorn et al.^{35,36} On the contrary, other studies did not find any association between GDM with education, or with socioeconomic status.³⁷⁻³⁹ A higher fraction of the pregnant mothers in our study were found suffering from anaemia (83%) compared to state average of 45.7% in pregnant women from rural areas.² This could be explained to poor dietary habits and local food culture. The independent association of GDM and anaemia adjusted for other variables showed an inverse relationship and in accordance with other studies examining the association of GDM and anaemia.⁴⁰ Increased iron stores in the general population have been associated with increased incidence of diabetes.⁴¹ There is evidence that high level of haemoglobin enhance the likelihood of developing type 2 diabetes mellitus or GDM.⁴² One study found that insulin resistance in pregnancy cause by excess iron stores might risk of developing.⁴³ Increased maternal ferritin concentration has been found at the time of diagnosis of GDM in the third trimester.⁴⁴ It is therefore indicates that women with iron deficiency anaemia have a reduced likelihood of GDM. In this study, we have focused on women with general anaemia irrespective of the cause, and we demonstrated that anaemia is independently associated with reduced prevalence of GDM. Furthermore, the prevalence of GDM was related to the duration and timing of anaemia.

CONCLUSION

The study is thought to be an initial research on GDM and its relation with anaemia. It definitely contributes to knowledge regarding anaemia and association with GDM, but the study did not consider the cause of anaemia and haemoglobin levels at different timing of gestation. Further research is warranted in this line to get in depth relationship with GDM. The study also paved the way for Government to implement routine screening of pregnant women for GDM. The Government should provide regular and comprehensive GDM and anaemia screening and treatment services for unreached population with proper guideline and sufficient resource allocation.

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