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Pregnancy Outcome As Influenced by Dietary Versus Insulin Management Among Gdm Mothers

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ABSTRACT

Gestational diabetes is a metabolic disorder characterized by carbohydrate intolerance first during pregnancy associated with foetal and maternal complications. The aim of the study is to assess the pregnancy outcome as influenced by dietary versus insulin management among GDM mothers. A total of 102 pregnant women, visiting the antenatal clinic of Apollo Hospitals, Bangalore were recruited for the study, classified as control and GDM groups based on the blood glucose levels using IADPSG guidelines, each group consisted of 51subjects. GDM group was further classified as diet managed group (n=23) and insulin managed group (n=28) depending on the modes of management. Biochemical profile was analyzed and recorded in both groups. Non-significantly higher term weight and a lower gestation week of delivery (37 ±1.51 weeks) and significantly higher HbA1c (6.5±1.02%) was observed in the insulin managed group when compared to the diet managed group, while, total cholesterol and triglyceride levels were significantly higher in the diet managed group ($p<0.03$ and 0.007) respectively. Caesarean section was common in both groups. The mean birth weight of the infants in both groups was comparable (2.9±0.3 and 2.8±0.52 kg). Whereas, significantly higher serum bilirubin levels were observed in infants born to insulin managed women (9 ±4.78 mg/dl), indicating a poor morbidity status in these infants. Medical nutrition therapy and insulin initiation are the two modes of blood glucose management in GDMs which aids in preventing complications and influencing near to normal pregnancy outcome.

Keywords: Gestational Diabetics, Morbidity status, Caesarean section, Antenatal clinic

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INTRODUCTION

"Gestational Diabetes is defined as any degree of glucose intolerance with onset or first recognition during the pregnancy". In pregnancy insulin sensitivity decreases, pregnant females are at greater risk to have deranged blood glucose levels and subsequently some of them develop gestational diabetes mellitus (GDM).Gestational diabetes mellitus is a common disorder affecting 1-14 % of all pregnancies[1].When GDM is left untreated, hyperglcaemic blood is carried to the foetus through placenta, leading to foetal hyper-insulinemia. This increased endogenous insulin acts as growth factors for foetus leading to storage of excessive amounts of glucose as glycogen and fat in the foetal body, making these babies larger than the normal. In large sized foetus oxygen demand increases causing hypoxic condition in utero, leading to structural and functional alterations in the placenta[2]. This affects the normal mechanism of functioning in human placenta with complex vascular system. Adequate growth and maturity of foeto-placental vessels are important for normal fetal growth and survival[3]. Complications of GDM encountered in foetus are increased birth weight, birth trauma, respiratory distress syndrome (RDS), hypoglycaemia, hyperbilirubinemia, polycythemia, hypocalcemia, major congenital anomalies, intrauterine deaths at term and even still births where as in mother there are more chances of excessive weight gain, pre-eclampsia, caesarean sections and development of Type 2 diabetes in subsequent years[4].

Blood glucose levels in the mother can be controlled by diet control and exercise, when diet control fails to maintain target glycaemic levels, insulin is initiated. Insulin is the traditional therapy and gold standard under such circumstances[5]. Despite these interventions like pharmacotherapy, foetal and maternal morbidity and mortality are well documented in the literature[6]. Therefore, there are different modes of managing blood glucose levels in GDMs. These modes of management might be helpful in explaining the adverse foetal and maternal outcomes in gestational diabetes. With this background present study was designed to observe the effect of diet and insulin management on foetal and maternal outcomes in gestational diabetics.

MATERIALS AND METHOD

Study design

A case-control descriptive and analytical study, conducted between July 2012 to July 2014 in Bangalore district of Karnataka.

Study site

Subjects were recruited from the antenatal clinic of Apollo Hospital, a multispecialty hospital from urban part of the district between the age group 20-39 years. This study was carried out after obtaining the ethics committee approval in Apollo Hospital, Bangalore and in

University of Mysore, Mysore. A total of 102 pregnant women were included for the study based on the willingness to participate by obtaining an informed consent. A pretested questionnaire was used to interview the subjects to elicit information for data collection. After recruiting the subjects for the study, pre-pregnancy anthropometric measurements, height and weight was recorded as self reported by the subjects and also from the medical records. Body mass index (BMI; Weight in kilograms divided by the square of the height in meters) was calculated using the pre-pregnancy anthropometry[7].

Subjects were classified as control and GDM groups based on the blood glucose levels using IADPSG guidelines[8], each group consisted of 51subjects. The GDM group was further classified as diet managed group (n=23) and insulin managed group (n=28) depending on the modes of management. Biochemical profile was analysed and recorded in both groups.

Data collection

Data regarding the subjects' background characteristics, personal and family medical history, lifestyle habits and behaviours, and course of pregnancy were collected by face-to-face interviews. The collected data included details like age, occupational status, education level, socio economic status, family history of co-morbidities, morbidity status of the subject, Gynaecology history, previous pregnancy complications, 24 hr dietary recall during pregnancy and physical activity levels.

Dietary recall

Dietary data was collected and analyzed using a 24 –hour diet recall questionnaire. Subjects were asked to recall foods taken over the past 24 hours using household measures relevant to Indian cuisine (serving bowls of various sizes, spoons or ladles) to assess the portion size. These food items were further converted to the raw food items and nutritive value was calculated. Data collected included information on current food frequency, dietary pattern and food habits. The data from 24hr recall were analyzed and nutritive value was calculated using the Indian food composition tables[9]. The regularity of intake and distribution of caloric and carbohydrate intake among meals and snacks throughout the day were determined.

Nutrient recommendations for each individual was calculated considering the pre-pregnancy weight (underweight, normal, overweight, or obese) and amount of weight gain during pregnancy (within normal range or excessive) according to the recommended dietary intake (RDI) using Indian food composition tables[9] .

The carbohydrate: protein: fat ratio was calculated according to the ICMR guidelines for pregnancy in the control group and GDM women as 50: 30: 20, 50% of the total calories from carbohydrates (more of complex carbohydrates), 30% of the total calories from fat and 20% of the total calories from protein[10]. Moreover, additional energy intake during pregnancy

is a major requirement to meet up the increasing demands of pregnancy and the increase in BMR, since, reduction in physical activity did not compensate for the maternal and foetal energy requirements[11].

Physical activity levels assessment

Physical activity levels were assessed in each group by filling a questionnaire, energy cost of activity was calculated[12]. The time spent on each group of activities was then multiplied by the energy cost of that activity (kcal/ kg body weight/hour). The energy cost of physical activities in a day was then totaled up. To adhere to the normal practices of presenting the energy cost of physical activities per day, the average of three consecutive days was calculated and the data was utilized for the study. Physical activity level and energy expenditure calculation was done using the WHO/FAO/UNU equation.

Statistical analysis

Data was analysed using SPSS statistics version 16.0. Mean and standard deviation were calculated for data pertaining to socio-demography, anthropometry, dietary intake and energy expenditure using t- test statistical significance testing between the two groups. The level of significance was set at $p<0.05$ for all analyses (two tailed).

RESULTS AND DISCUSSION

A total of 102 pregnant women were recruited for the study, 51 subjects were control subjects and 51 were Gestational diabetics in the study, these subjects were drawn from Apollo Hospital, Bangalore.

Socio demographic characteristics of study population:

As shown in Table 1, the mean age of GDM women and control group was 29.05 y ± 3.55 and 28.49 y ± 3.54, BMI was 25.58 kg/m^2 and 24.0 kg/m^2 respectively. Comparison of pre pregnancy weight among the subjects revealed that the control group had a higher percentage of women with normal body weight 37.25%, overweight subjects were also higher in the control group 27.4%, whereas, a higher percentage of women in obesity category Grade I and II were observed in GDM women 47.1%. Though a difference was observed between the two groups, it was statistically not significant ($p= 0.570$). Therefore, it is crucial to attain adequate pre-pregnancy weight and appropriate weight gain to experience normal course of pregnancy and reduce the risk of complications associated with pregnancy outcome. Majority of women in the GDM group 62.7% had family history of type 2 diabetes was when compared with the control group, this difference was statistically significant ($p< 0.05$), indicating that presence of family history of Type 2 diabetes is one of the contributing risk factors for the onset of gestational diabetes. Occupational status of the subjects did not have a significant contribution ($p>0.05$), for the onset of gestational diabetes.

Table 1: Descriptive socio-demographic characteristics of the subjects (n=102)

	GDM women n=51 Mean(±SD)	Control subjects n=51 Mean(±SD)	p value
Age (yrs)	29.05(±3.55)	28.49(±3.54)	0.420
Height(cms)	157.4(±6.77)	159.1(±5.66)	0.186
Weight (kgs)	63.41(±9.84)	60.75(±8.65)	0.150
BMI (kg/m^2)	25.58 (±3.50)	24.02 (±3.18)	0.019*
	Mean n (%)	Mean n (%)	
Underweight		2(3.92%)	
Normal	13(25.5%)	19(37.25%)	0.057
Overweight	8(15.7%)	14(27.4%)	
Obesity Grade I	24(47.1%)	14(27.4%)	
Obesity Grade II	6(11.76%)	2(3.92%)	
Family history of Diabetes	32(62.7%)	20(39.2%)	0.017*
Employed	29(56.9%)	29(56.9%)	
Home makers	22(43.1%)	22(43.1%)	1.000

*Statistically significant

Table 2, depicts that nutrient consumption of control group was better than GDM group subjects, the difference in energy and CHO intake was statistically significant.

Table 2: Comparison of nutrients intake between the two groups

Nutrient Intake	GDM Women Mean ±SD Intake	Control Group Mean ±SD Intake	p value
Energy(kcals)	1844(±304)	1968(±297.61)	0.04*
Protein(gms)	57 (±11)	58(±8.50)	0.800
Fat(gms)	67.50(±17)	69(±16)	0.746
CHO(gms)	239(±46)	265(±36)	0.002*

RDI-Recommended Dietary Intake, GDM- Gestational Diabetes Mellitus

*Statistically significant $p<0.05$

Time allocation and energy expenditure was calculated for activities like household work, personnel work, commuting, office work, recreation, rest & sleep and child care and compared between the groups. The findings of the study demonstrated that the time allocation and energy expenditure was significantly different between the two groups ($p < 0.05$) for child care.

Biochemical parameters were compared between both groups, blood glucose levels of the subjects were managed with diet control and insulin therapy. Diet control consisted of carbohydrate restrictions, initiation of complex carbohydrate, small and frequent meals and high fibre intake on a daily basis. When medical nutrition therapy failed to control blood glucose levels, insulin therapy was initiated, which involves administration of insulin injections as prescribed, which varies depending on the glycaemic control in the subjects. Insulin therapy increases the risk of maternal hypoglycaemia leading to adverse pregnancy

outcome.

Initially, a very low dosage of short acting insulin such as human actrapid was started, later, the dosage was adjusted based on the glycaemic control. Additionally, a combination of short acting and long acting insulin was prescribed. However, it was observed that the dosage of insulin was increasing with the progression in pregnancy. In this study, women were prescribed with insulin formulations such as human actrapid, insulatard, lispro, levemir etc., the dosage was ranging between 4 units to 40 units maximum in these subjects.

In table 3, blood glucose levels of diet and insulin managed GDM subjects are reported, in fasting and postprandial conditions in the third trimester at different time points, 28-32, 33-36, 37-41 weeks of gestation. The observed values reveal that FBS and PPBS values were exceeding the desirable range of blood glucose levels in both groups, and were in the comparable range. This was probably due to the regular follow-up of GDM women in the antenatal clinic of the hospital and the impact of personalised diet chart they received, that controlled calories and carbohydrate consumption. The difference in the blood glucose levels (FBS& PPBS) was significantly different at different time points in this study (F= 4.267 and F=21.53). This table also depicts the HbA1c levels of GDM subjects, which is significantly different between the different time points.

Table 4, reveals that there was a significant difference in the birth weights of infants born to Control group subjects, diet and insulin managed GDM group subjects. Gestation week was significantly lower in the insulin managed group ($p<0.05$), chest circumference (33.17cm) was significantly higher than the diet managed group ($p<0.05$). The other anthropometric parameters such as weight and HC was higher in the diet managed group (2.92cm) and (33.52cm) respectively. Diet managed group had taller babies compared with the insulin treated group (48.80 cm). However, total cholesterol (214±47.7mg/dl) and triglyceride levels (220±11.9mg/dl) were significantly higher in the diet managed group compared to insulin managed groups ($p<0.03$ and 0.007) respectively, while HbA1c (6.5%) was found to be higher in the insulin managed group. The difference was statistically significant only for the difference in CC in the infants born to these subjects. Although, there was a difference between the subgroups, for parameters such as HC, CHL, BMI and BSA, it was statistically not significant, indicating that the birth parameters were in the comparable range in the subgroups. Therefore, when MNT fails to control blood glucose levels, insulin is the last and reliable option for reducing the adverse pregnancy outcome.

Table 3: Biochemical parameters of diet and insulin managed GDM Subjects (mean±SD)

Group	Blood Glucose levels(mg/dl)(n= 51)						
	28-32 weeks		33-36 weeks		37-41 weeks		F value (p value)
	FBS Mean±SD	PPBS	FBS	PPBS	FBS	PPBS	
Haemoglobin(Hb)	11.77±1.42		11.6±1.30		11.6±1.16		0.477NS
HbA1c(g/dl)	6.12±0.87[@]		6.00±0.57[&]		5.7±0.48		11.56*
Diet managed(mg/dl)n=23	110±36.2	143±37.3	133±11.60	152±22.47	130±15.3	156±23.04	4.167*(0.020)
Insulin Managed(mg/dl) n=28	123±70.0	147±23.9	133±25.5	149±27.5	128±23.7	161±23.18	21.53*(0.001)

- FBS-Fasting Blood sugars, PPBS- Post Prandial Blood Sugars
- HbA1c- glycosylated haemoglobin, [@]HbA1C at 28weeks and [&]HbA1C 32 weeks differ significantly from the HbA1C of 36 weeks
- *Significant at 5% level
- NS- Non Significant

Table 4: Neonatal birth parameters of infants born to diet and insulin managed group subjects in GDMs

	Gestation weeks	Birth weight kg	HC cm	CC cm	CHL cm	BMI kg/m^2	BSA m^2	Serum Bilirubin mg/dl	HbA1C g%
Control(n=45)	37.71±1.32	2.87±0.42	33.84±2.07	31.76±2.78	47.58±3.48	12.8±2.54	0.17±0.7	7.12±3.98	NA
Diet(n=30)	38.1±1.1	2.9±0.3	33.07±1.03	32.50±0.51	48.35±3.5	12.3±2.1	0.20±0.02	7.2±3.2	6.0±0.5
Insulin(n=23)	37.1±1.51	2.8±0.52	32.88±2.5	33.17±0.6	48.20±2.6	11.9±1.7	0.19±0.02	9.0±4.78	6.5±1.02
t value	2.64 *	0.81NS	0.488 NS	3.82*	0.17 NS	1.82 NS	1.80 NS	1.53 *	2.00 *
p value	0.01	0.42	0.7	0.00	0.15	0.07	0.07	0.049	0.005

*Significant at 5% level

NS – Non significant

NA –Not Applicable

The present study aimed to investigate pregnancy outcome as influenced by dietary management versus insulin treatment among GDM mothers. Obese and overweight women are at a greater risk for the onset of gestational diabetes and presence of family history of Type 2 Diabetes increases the risk by multiple folds. To ensure a better outcome of pregnancy it is important to maintain normal body weight before pregnancy[13]. Maternal obesity is also known to increase the risk of childhood obesity and diabetes in the off springs [1]. It is also important to have adequate gestational weight gain which has substantial impact on maternal health and would lead to better obstetric management[14]. It is also reported that pre pregnancy weight management decreases the risk of gestational diabetes in women[15]. This study demonstrates that increase in age is not always directly proportional to the onset of gestational diabetes, while, >30 years the risk of gestational diabetes is higher[16]. Family history of diabetes is the predisposing factor for the onset of Gestational Diabetes[17]. However, presence of family history of type 2 diabetes increases the risk of GDM by three folds [18].

Maternal food intake during pregnancy, particularly, in the second trimester was associated with a risk of abnormal glucose metabolism later in pregnancy[19]. Macronutrient intake was found to be higher in the control group than GDM women, indicating that control group subjects had better food intake than GDM women. The difference in energy intake and expenditure was significant and was indicating a negative energy balance among these subjects. This observation could be due to a greater percentage of subjects were from a higher educational background with adequate information and awareness about the additional nutrition requirements during pregnancy[20].

This study demonstrates that women are more sedentary during pregnancy and do not have schedule for physical activity, this observation is similar to the study that states there is decrease in the intensity of physical activity and preferred more sedentary activities like household activities, recreation, rest and sleep [21].

Biochemical parameters reflect these adaptive changes and are totally different from the non-pregnant state. The woman's renal function, carbohydrate and protein metabolism, and particularly the hormonal pattern are affected. It is critical to appreciate both normal and abnormal changes as laboratory results can influence the management of both mother and child [22]. Pregnancy is characterized by a progressive increase in nutrient-stimulated insulin responses despite an only minor deterioration in glucose tolerance, consistent with progressive insulin resistance.

Changes in carbohydrate and lipid metabolism occur during pregnancy to ensure a continuous supply of nutrients to the growing foetus despite intermittent maternal food

intake. These metabolic changes are progressive and may be accentuated in women who develop gestational diabetes mellitus [23].

During early pregnancy there is an increase in body fat accumulation, associated with both hyperplasia and increased lipogenesis because maternal cholesterol is the source of cholesterol for the foetus during early gestation, which reduces during late pregnancy due to the capacity of foetal tissues to synthesize cholesterol. Maternal hypertriglyceridemia is also a characteristic feature during pregnancy and leads to an accumulation of triglycerides. Triglycerides do not cross the placental barrier [24]. This suggests there is a rise in serum lipid levels during pregnancy. The occurrence of altered serum lipid profile was seen in the GDM group women. In the present study, it was found that serum triglycerides were significantly different between the two groups.

It is very interesting to note that even the control group subjects had elevated TC, TG and LDL levels similar to the GDM group, except that the number of subjects was lesser than GDM women. Moreover, TC and TG levels were found to be higher in the diet managed group than the insulin managed group.

Foetal macrosomia is commonly associated with gestational diabetes mellitus (GDM) which may lead to various complications. A better control and regulation of serum lipids along with glycaemic control may prevent the occurrence of foetal macrosomia. In GDMs fasting and post prandial blood sugar levels with HbA1c is monitored at regular intervals to control blood glucose levels for better outcome of pregnancy.

The HbA1c level is proportional to average blood glucose concentration over the previous four weeks to three months. HbA1c assay cannot be used as a single marker to diagnose gestational diabetes; it is a low predictive value to diagnose gestational diabetes 26. Fong et al. found that women with HbA1c of 5.7-6.4 % at first prenatal visit (up to 20 weeks of gestation) had a 3-fold higher risk of developing GDM compared to those with HbA1c < 5.7 % 27.

During pregnancy an increase in plasma volume causes hemodilution resulting in a lowering of the haemoglobin (Hb) to approximately 11.5 g/dl [28]. In the present study, Hemoglobin levels were recorded to be almost similar in all the trimesters, it from 11.6 to 11.77mg/dl. A significant difference in the Hb levels were not reported between the trimesters.

GDM women were subjected to regular blood glucose monitoring using a glucometer was designed to cover fasting and postprandial blood sugars in a day. It is observed that there was a significant difference in the blood glucose levels between trimesters in these two groups. Blood glucose management was through diet control initially, subsequently, insulin therapy was initaited. Therefore, results of the study confirm that the GDM subjects were visiting

the ANC and were compliant with the dietary modifications prescribed by the Dietitian. It also suggests that initiation of insulin therapy when fasting blood glucose is >95 mg/dl with dietary modifications may achieve lower rates of macrosomia[29]. However, prophylactic insulin therapy was not advised in subjects with rigid glycaemic control. Patients on insulin therapy have lower rate of complications when compared with diet managed subjects despite achieving the same glycaemic goals. This implies that other factors may be associated with the pathogenesis of adverse outcomes in GDM [30].

CONCLUSION

Comparison of diet versus insulin management on pregnancy outcome among GDM group revealed that subjects in the insulin managed group reported lower gestation week at delivery and higher HbA1c levels than the diet managed group. Moreover, significantly higher total cholesterol and triglyceride levels were demonstrated in diet managed group. Therefore, it indicates that the diet managed group subjects were liberal in food consumption and ignorant about the complications that can occur during pregnancy, especially, when diagnosed as gestational diabetic. It was also observed that serum bilirubin levels were higher in the infants born to insulin managed group, indicative of a poor morbidity status. This might be the adverse impact of high blood sugar levels requiring insulin therapy.

The neonatal parameters of the infants born to diet managed and insulin managed groups indicates that outcome of pregnancy between the two groups of infants was in the comparable range, thus, insulin intervention has positively influenced the outcome of pregnancy among GDM subjects.

Overall, gestation performance and birth outcomes are interdependent factors that influence the outcome of pregnancy to a greater extent. Therefore, these factors are termed as crucial components for pregnancy outcome, which require intense monitoring, whereas, in this study mode of blood glucose management also has been found to have an impact on pregnancy outcome. Furthermore, the recommendations to the clinicians is to maintain tight glycaemic control in GDM subjects by initiating the recommended modes of blood glucose management to facilitate normal pregnancy outcome.

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