"PREVALENCE OF GESTATIONAL DIABETES MELLITUS AMONG PREGNANT WOMEN ATTENDING ANTENATAL CLINIC AT THREE URBAN HEALTH CENTRES OF BELAGAVI – A CROSS SECTIONAL STUDY"

Submitted by

(REG.NO.BD0113002)

DISSERTATION

Submitted to the
KLE University, Belagavi, Karnataka

In Partial Fulfillment of the requirements for the degree of

DOCTOR OF MEDICINE (M. D.)

in

COMMUNITY MEDICINE

**DEPARTMENT OF COMMUNITY MEDICINE,
JAWAHARLAL NEHRU MEDICAL COLLEGE,
BELAGAVI, KARNATAKA**

APRIL 2016

KLE UNIVERSITY, BELAGAVI, KARNATAKA

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LIST OF ABBREVIATIONS USED

ADA	-	American Diabetes Association
BMI	-	Body Mass Index
CI	-	Confidence Interval
Cms	-	Centimeters
DM	-	Diabetes Mellitus
DIPSI	-	Diabetes In Pregnancy Study group India
Df	-	Degree of Freedom
FPG	-	Fasting Plasma Glucose
gm	-	Grams
GD	-	Gestational diabetes
GDM	-	Gestational Diabetes mellitus
GCT	-	Glucose Challenge Test
HAPO	-	Hyperglycemia and Adverse Pregnancy Outcome
Hb	-	Haemoglobin
HbA1c	-	Glycosylated Haemoglobin
IADPSG	-	International Association of Diabetes and Pregnancy Study Groups
IDM	-	Infant of Diabetic Mother
IGT	-	Impaired Glucose Tolerance
Kg	-	Kilogram

LGA	-	Large for Gestation Age
LSCS	-	Lower Segment Caesarean Section
mg/dL	-	Milligram per deciliter
MVPA	-	Moderate Vigorous Physical Activity
NDDG	-	National Diabetes Data Group
OR	-	Odds Ratio
OGTT	-	Oral Glucose Tolerance Test
PCOS	-	Polycystic Ovarian Syndrome
PG	-	Plasma Glucose
PGDM	-	Pre Gestational diabetes mellitus
PUC	-	Pre University College
RDS	-	Respiratory Distress Syndrome
SD	-	Standard Deviation
SPSS	-	Statistical Product and Service Solutions
T2DM	-	Type 2 Diabetes mellitus
UHCs	-	Urban Health Centres
WHO	-	World Health Organization
χ^2	-	Chi – square test

ABSTRACT

Background and Objectives

Gestational diabetes mellitus (GDM) is defined as any degree of glucose intolerance with the onset or first recognition during pregnancy with or without remission after the end of pregnancy. The prevalence of GDM in India varies from 3.8 to 21% in different part of country, depending on geographical locations. GDM is associated with increased incidence of maternal hypertension, pre-eclampsia, obstetric intervention and risk of developing Diabetes mellitus (DM) in later life. Hence, this study was undertaken to find out prevalence of gestational diabetes mellitus in pregnant women attending Antenatal Clinic of three Urban Health Centres (UHCs) and to determine the risk factors associated with gestational diabetes mellitus.

Methodology

This one year cross sectional study was done in three UHCs Ashok Nagar, Ram Nagar and Rukmini Nagar, which are urban field practice area of Jawaharlal Nehru Medical College, Belagavi. Data was collected from 360 pregnant women attending the antenatal clinic of three UHCs. Information on socio demographic details and risk factors associated with GDM was obtained. Woman was given a standardized 75gm of oral glucose load, irrespective of whether she was in fasting or non fasting state and without regard to time of last meal, and plasma glucose was estimated at 2 hours by using Diabetes in Pregnancy Study group India (DIPSI criteria) and all women with a plasma glucose of ≥ 140 mg/dl were diagnosed to have GDM.

Results

The prevalence of GDM in this study was 12.2%. In the present study mean age of study participants was 24.3±3.92 years, 54.7% were Muslim by religion. A large number of study participants had studied up to high school 37.8%. As many 95.3% pregnant women were housewives. Most of participants belonged to class III socio-economic status as per modified B G Prasad classification. In this study, 48.1% pregnant women were in first trimester. 53.3% were multigravida and 46.7% were primigravida. History of abortion was present in 15.2% participants of study participants.

Only 1.1% participants had previous history of GDM and 1.6% participants had previous history of macrosomia. Majority 70.8% did not have family history of diabetes and 38.3% pregnant women did not have any physical activity. Mean BMI of the study participants was 22.48±3.05 kg/m^2.

There was statistically significant difference was observed in risk factors such as age, gravidity, previous history of abortion, previous history of GDM, previous history of macrosomia, previous history of LSCS, family history of diabetes and physical activity with GDM.

The trends association was observed statistically significant in age associated with GDM (p=0.012) as the age was increased the prevalence of GDM was increased. In BMI trends association was observed statistically significant as the BMI increased the prevalence of GDM was increased (p=0.007) and in socio-economic status the trends of prevalence of GDM decreased as socio-economic status decreased which was found to be statistically significant also (p=0.03) in this study. .

Conclusion

In this study there is a greater prevalence of GDM in women with increasing age, higher parity, increasing BMI and a family history of diabetes mellitus. There is a need for universal screening to pick up gestational diabetes mellitus to prevent both maternal and fetal morbidity. Based on these results it concluded that, the diagnosis of GDM based on DIPSI method is a convenient, quick and cost effective.

Keywords: Gestational diabetes mellitus, DIPSI criteria, Urban area.

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INTRODUCTION

Gestational Diabetes mellitus (GDM) is defined as any degree of glucose intolerance with the onset or first recognition during pregnancy with or without remission after the end of pregnancy.[1] Diabetes mellitus (DM) complicating pregnancy is now a common entity worldwide, which include Pregestational Diabetes mellitus (PGDM) and GDM.[2] GDM occur in women in whom beta cell function is not able to overcome the antagonism created by anti insulin hormones of pregnancy. An increase in beta cell mass and insulin secretion in the fetus occurs by the early weeks of gestation, in response to maternal hyperglycemia.[3] The priming of fetal beta cells may account for the persistence of fetal hyperinsulinemia throughout the pregnancy and risk of accelerated fetal growth.[4] GDM is associated with increased incidence of maternal hypertension, pre-eclampsia, obstetric intervention and risk of developing DM in later life. Major morbidities associated with infants of diabetic mothers include respiratory distress, growth restriction, polycythemia, hypoglycemia, congenital malformations and perinatal mortality.[5]

It is estimated that around (1-14%) of all pregnant women worldwide develop GDM. GDM affects about 7% pregnancies resulting in approximately 200,000 cases each year in the United States, depending on the diagnostic criteria used and characteristics of the population. 30-50% of women with GDM will have recurrent GDM in a future pregnancy. Of particular concern, 20-50% of women with GDM will develop type 2 diabetes mellitus (T2DM) in the 5-10 years after delivery. Recent meta-analysis reports that GDM corresponds to a 7.4 fold increased risk for developing T2DM.[6,7]

The scenario in India today is that there are over 43 million diabetics in the country. There are 14 million women in India, in the age group of 20 to 39 years who are considered in the child bearing age. In Indian context the prevalence of GDM is steadily increasing from two percent in 1982 to 12% in 1991 and it has almost doubled to 16.55% in 2002. The prevalence of GDM in India varied from 3.8 to 21% in different part of the country, depending on the geographical locations and diagnostic method used. GDM has been found to be more prevalent in urban areas than in rural areas.[7]

Appropriate diagnosis and management of GDM can improve maternal and perinatal outcome. It is possible that a higher prevalence of GDM may be present among the urban population due to the adoption of unhealthy life style. Limited studies regarding the prevalence and risk factors associated with GDM among the urban population has been reported from Karnataka. Most of the time pregnant women do not come in the fasting state because of commutation and belief not to fast for long hours. The dropout rate is very high when a pregnant woman is asked to come again for the glucose tolerance test. Attending the first prenatal visit in the fasting state is impractical in many settings. The one step diagnostic procedure, Diagnosis In Pregnancy Study Group India (DIPSI) method is easy to perform, cost-effective and causes least disturbances in a pregnant woman's routine activities. Hence, this study is undertaken to estimate the current prevalence of GDM in urban area of Karnataka and to study its associated risk factors. This study may also provide evidence for routine screening of all pregnant women using DIPSI method.[8]

OBJECTIVES

- To find out prevalence of gestational diabetes mellitus in pregnant women attending Antenatal Clinic of three Urban Health Centres (UHCs).
- To determine the risk factors associated with gestational diabetes mellitus.

REVIEW OF LITERATURE

GESTATIONAL DIABETES MELLITUS

History

Gestational diabetes (GD) as a clinical entity which began in 1979 when the National Diabetes Data Group (NDDG) issued an updated classification of diabetes types, including one that was present only during pregnancy. In 1979, the First International Workshop-Conference on GDM also met, essentially declared GD a disease, finding it an important health risk that needed treatment. Instead of the more neutral "Carbohydrate Intolerance of Pregnancy", the term "Gestational Diabetes Mellitus" was used .[9]

Hadden (1998) reports incidents in the medical literature appearing as early as 1823 where diabetic-like conditions presented during pregnancy but seemed to disappear afterwards. However, greater consideration to the concept that lesser degrees of hyperglycemia might negatively affect a pregnancy began to appear in the 1940s and 1950s. In these studies, it was found that there is increased perinatal mortality among the babies of women who developed diabetes years later, leading to the coining of the term "prediabetes in pregnancy".[10]

The first major prospective study was established in Boston in 1954, and the one hour 50 gm glucose screening test was first used there. However, the stress was on criteria that established risk for future diabetes, not on risk to the fetus. The results from this Boston study were presented by O'Sullivan and Mahan in 1964, and showed

that higher blood glucose values in pregnancy correlated with the development of diabetes later in life.[10]

Risk Factors

Risk factors for gestational diabetes differ from study to study, but some remain consistent.[11] These are listed as 'strong' associations solely due to their consistency of appearance in each study, and are put near the top. Others whose associations are less clear are listed towards the bottom.[12,13]

- Family history of diabetes
- Parity (number of children, especially 3-4 or more)
- Previous pregnancy with GDM
- Obesity
- Previous child over 4000 g
- Unexplained multiple miscarriages, stillbirths, or birth defects
- Weight gain in early adulthood
- Central fat distribution
- PCOS (Polycystic Ovarian Syndrome)
- Tobacco consumption
- Multiple Pregnancies
- History of Skin/Urinary Tract/Genital Infections
- Hypertension
- Chronic Steroid Use
- Non-white ethnicity

The risk in Asians is less clear. Southeast Asians had increased rates, while Korean women had very low rates. Chinese women clearly had increased rates, especially if they were immigrants, but those in China also had slightly higher rates too. Japanese-Americans also have increased rates.[11]

Women from India had very high rates in some areas, second only to those of Native Americans. However, not all areas of India showed such high rates. Arabic women also had slightly increased rates of GDM.[11]

Pathophysiology

Maternal-fetal metabolism in normal pregnancy

With each feeding, the pregnant women undergo a complex series of maternal hormonal actions (a rise in blood glucose; the secondary secretion of pancreatic insulin, glucagon, somatomedins, and adrenal catecholamines). These adjustments ensure that an ample, but not excessive, supply of glucose is available to the mother and fetus.[12]

The key features of this complex interaction include compared to non-pregnant subjects, pregnant women tend to develop hypoglycemia (plasma glucose mean = 65 to 75 mg/dL) between meals and during sleep. This occurs because the fetus continues to draw glucose across the placenta from the maternal bloodstream, even during periods of fasting. Interprandial hypoglycemia becomes increasingly marked as pregnancy progresses and the glucose demand of the fetus increases.[12]

Levels of placental steroid and peptide hormones (estrogens, progesterone, and chorionic somatomammotropin) rise linearly throughout the second and third trimesters. Because these hormones confer increasing tissue insulin resistance as their

levels rise, the demand for increased insulin secretion with feeding escalates progressively during pregnancy. Twenty-four–hour mean insulin levels are 50% higher in the third trimester compared to the non-pregnant state.[12]

If the maternal pancreatic insulin response is inadequate, maternal and fetal hyperglycemia results. This typically manifests as recurrent postprandial hyperglycemic episodes. These postprandial episodes are most significantly accountable for the accelerated growth exhibited by the fetus.[12]

Surging maternal and fetal glucose levels are accompanied by episodic fetal hyperinsulinemia. Fetal hyperinsulinemia promotes excess nutrient storage, resulting in macrosomia. The energy expenditure associated with the conversion of excess glucose into fat causes depletion in fetal oxygen levels.[12]

These episodes of fetal hypoxia are accompanied by surges in adrenal catecholamines, which, in turn, cause hypertension, cardiac remodelling and hypertrophy, stimulation of erythropoietin, red cell hyperplasia, and increased haematocrit. Polycythemia (haematocrit >65%) occurs in 5-10% of newborns of diabetic mothers. This finding appears to be related to the level of glycemic control and is mediated by decreased fetal oxygen tension. High haematocrit values in the neonate lead to vascular slugging, poor circulation, and postnatal hyperbilirubinemia.[12]

During a healthy pregnancy, mean fasting blood sugar levels decline progressively to a remarkably low value of 74 ± 2.7 mg/dL. On the other hand, peak postprandial blood sugar values rarely go beyond 120 mg/dL. Meticulous replication of the normal glycemic profile during pregnancy has been demonstrated to reduce the

macrosomia rate. Specifically, when two postprandial glucose levels are maintained less than 120 mg/dL, approximately 20% of fetuses demonstrate macrosomia. Conversely, if postprandial levels range up to 160 mg/dL, macrosomia rates rise to 35%.[12]

Pathogenesis of glucose intolerance in pregnancy

A. Genetic factors

Increasing maternal age and obesity

B. Gestational factors

- Autoimmune destruction of islet cells
- Impaired beta cell function
- Antagonistic effect of pregnancy hormones
- Increased insulin degradation
- Impaired insulin – Receptor binding
- Post – Receptor defect in insulin signaling cascade mediated by TNF-α.[12]

C. Role of Leptin

Leptin, a product of obesity (ob) gene, is produced and secreted by the adipose tissue. Its plasma levels are significantly elevated in pregnant than in non pregnant women, indicating pregnancy to be a leptin – resistant state.[12]

Effects of diabetes on fetus

Miscarriages

In all women with pre-existing diabetes mellitus, there is a 9-14% rate of miscarriage. Current data suggest a strong association between degree of glycemia control prior to pregnancy and miscarriage rate. Suboptimal glycemia control has been shown to double the miscarriage rate in women with diabetes. A correlation also exists between more advanced diabetes and miscarriage rates. Patients with long-standing (>10 y) and poorly controlled (glycosylated haemoglobin exceeding 11%) diabetes have been shown to have a miscarriage rate of up to 44%. Conversely, reports demonstrate a normalization of miscarriage rate with excellent glycemic control.[13]

Birth defects

Among the general population, major birth defects occur in one to two percent of the population. In women with overt diabetes and suboptimal glycemic control prior to conception, the likelihood of a structural anomaly is increased four to eight fold. Although initial reports demonstrated anomaly rates as high as 18% in women with pre-existing diabetes mellitus,[14] more recent reports with more aggressive preconception and first trimester management report anomaly rates between 5.1 and 9.8%.[14,15] Two-thirds of anomalies involve the cardiovascular and central nervous systems.[15]

Neural tube defects occur 13 to 20 times more frequently in diabetic pregnancy. Genitourinary, gastrointestinal, and skeletal anomalies are also more common. The fact that no increase in birth defects occurs among the offspring of fathers who are diabetic and women who develop gestational diabetes after the first

trimester is notable. This suggests that peri-conceptional glycemic control is the main determinant of abnormal fetal development in diabetic women.[16,17]

When the frequency of congenital anomalies in patients with normal or high first-trimester maternal glycosylated haemoglobin values was compared to the frequency in healthy patients, the rate of anomalies was only 3.4% with HbA1C of less than 8.5%, whereas patients with poorer glycemic control in the periconceptional period (HbA1C >8.5%) had a 22.4% rate of malformations. An overall malformation rate of 13.3% was reported in 105 patients with diabetes, but the risk of delivering a malformed infant was comparable to a normal population when the HbA1c was less than seven percent.[16] In a review of seven cohort studies, it has been found that patients with a normal glycohaemoglobin (0 SD above normal), the absolute risk of an anomaly was two percent. At two SD above normal, this risk was 3%, with an odds ratio of 1.2 (1.1 to 1.4). As the glycohaemoglobin increased the risk for malformation increased.[17]

Growth restriction

Although most fetuses of diabetic mothers exhibit growth acceleration, growth restriction occurs with significant frequency in pregnancies in women with pre-existing type 1 diabetes.[12] The most important predictor of fetal growth restriction is underlying maternal vascular disease. Pregnant patients with diabetes-associated retinal or renal vasculopathies and/or chronic hypertension are most at risk for growth restriction.[16,18]

Growth acceleration

Excessive body fat stores, stimulated by excessive glucose delivery during diabetic pregnancy, often extends into childhood and adult life.[12]

Approximately 30% of fetuses of women with diabetes mellitus in pregnancy are large for gestational age (LGA). In pre-existing diabetes mellitus this incidence appears slightly higher, 38%. Maternal obesity, common in type 2 diabetes, appears to significantly accelerate the risk of infants being LGA.[12]

Fetal obesity

Macrosomia is typically defined as a birth weight above the 90th percentile for gestational age or greater than 4000 grams. In pregnant diabetic women, macrosomia occurs in 15 to 45% of cases, a threefold raise from normoglycemic controls.[19]

Newborns with macrosomia experience excessive rates of neonatal morbidity, as illustrated by a study by Hunter et al in 1993, which compared the neonatal morbidity among infants of 230 women with insulin-dependent diabetes and infants of 460 women without diabetes. The infants of diabetic mothers (IDMs) had five fold higher rates of severe hypoglycemia, a fourfold increase in macrosomia, and a doubled increase in neonatal jaundice.[20]

The macrosomic fetus in diabetic pregnancy develops a unique pattern of overgrowth, involving central deposition of subcutaneous fat in the abdominal and interscapular areas.[21] Skeletal growth is largely unaffected. Neonates of diabetic mothers have a larger shoulder and extremity circumference, a decreased head-to-shoulder ratio, significantly higher body fat, and thicker upper extremity skin folds compared to non diabetic control infants of similar weights. Since fetal head size is

not increased during poorly controlled diabetic pregnancy but shoulder and abdominal girth can be markedly augmented, the risk of injury to the fetus after delivery of the head (eg Erb palsy) is significantly increased.[19,20]

When serial ultrasonographic examination findings from diabetic fetuses are plotted, the growth velocity of the abdominal circumference is often well above the growth centiles seen in non diabetic fetuses and is higher than the fetal head and femur centiles. The accelerated growth of the abdominal circumference begins to rise significantly above normal after 24 weeks.[19,20]

Metabolic syndrome

The adverse effects of abnormal maternal metabolism on the offspring have been documented well into puberty. Glucose intolerance and higher serum insulin levels are more frequent in children of diabetic mothers as compared to normal controls. By age 10 to 16 years, offspring of diabetic pregnancy have a 19.3% rate of impaired glucose tolerance.[22]

The childhood metabolic syndrome includes childhood obesity, hypertension, dyslipidemia, and glucose intolerance. A growing body of literature supports a relationship between intrauterine exposure to maternal diabetes and risk of a metabolic syndrome later in life.[22,23] Fetuses of diabetic women that are born large for gestational age appear to be at the greatest risk.[24]

Perinatal morbidity and birth injury

Perinatal mortality

In diabetic pregnancy, perinatal mortality has decreased 30-fold since the discovery of insulin in 1922 and intensive obstetrical and infant care in the 1970s. However, the current perinatal mortality rates among women who are diabetic remain approximately twice those observed in the non diabetic population.[25,26]

Congenital malformations, respiratory distress syndrome (RDS), and extreme prematurity account for most perinatal deaths in contemporary diabetic pregnancies.[27,28]

Birth injury

Injuries of birth, including shoulder dystocia and brachial plexus trauma, are more common among infants of diabetic mothers, and macrosomic fetuses are at the highest risk.[13]

Most of the birth injuries occurring to infants of diabetic mothers are associated with difficult vaginal delivery and shoulder dystocia. While shoulder dystocia occurs in 0.3-0.5% of vaginal deliveries among healthy pregnant women, the incidence is two to four fold higher in women with diabetes. With strict glycemic control, the birth injury rate has been shown to be only slightly higher than controls (3.2 vs 2.5%).[13]

Polycythemia

A central venous haemoglobin concentration greater than 20 gm/dL or a hematocrit value greater than 65% (polycythemia) is common in infants of diabetic

mothers and is related to glycemic control. Hyperglycemia is a powerful stimulus to fetal erythropoietin production mediated by decreased fetal oxygen tension. Untreated neonatal polycythemia may promote vascular slugging, ischemia, and infarction of vital tissues, including the kidneys and central nervous system.[13]

Hypoglycemia

Approximately 15-25% of neonates delivered from women with diabetes during gestation develop hypoglycemia during the immediate newborn period.[25] Neonatal hypoglycemia is less common when tight glycemic control is maintained during pregnancy and in labor. Unrecognized postnatal hypoglycemia may lead to neonatal seizures, coma and brain damage.[26]

Neonatal hypocalcaemia

Up to 50% of infants of diabetic mothers have low levels of serum calcium (<7 mg/100ml). With better management of diabetes in pregnancy, this occurrence has been reduced to 5% or less. These changes in calcium appear to be attributable to a functional hypoparathyroidism, though the exact pathophysiology is not well understood.[13]

Postnatal hyperbilirubinemia

Hyperbilirubinemia occurs in approximately 25% of infants of diabetic mothers, a rate approximately double that in a healthy population. The causes of hyperbilirubinemia in infants of diabetic mothers are many, but prematurity and polycythemia are the major contributing factors. Increased destruction of red blood cells contributes to the risk of jaundice and kernicterus. Treatment of this complication

is usually by phototherapy, but exchange transfusions may be necessary if bilirubin levels are markedly elevated.[13]

Respiratory problems

Neonatal RDS was the most common and serious morbidity in infants of diabetic mothers. In the 1970s, improved prenatal maternal management for diabetes and new techniques in obstetrics for timing and mode of delivery resulted in a decrease in its incidence from 31% to 3%.[27] However, respiratory distress syndrome continues to be a relatively preventable complication.[27]

The majority of the literature indicates significant biochemical and physiological delay in infants of diabetic mothers.[28] Landon and his colleagues reported that fetal lung maturity occurred later in pregnancies with poor glycemic control regardless of class of diabetes when infants were stratified by maternal plasma glucose levels.[29]

The non diabetic fetus achieves pulmonary maturity at a mean gestational age of 34-35 weeks. By 37 weeks gestation, more than 99% of healthy newborn infants have mature lung profiles as assessed by phospholipids assays. However, in a diabetic pregnancy, presuming that the risk of respiratory distress has passed is unwise until after 38.5 gestational weeks have been completed.[28]

Effects of diabetes on mother

Diabetic retinopathy

It is the leading cause of blindness in women aged 24-64 years. Some form of retinopathy is present in virtually 100% of women who have had type 1 diabetes for

25 years or more; of these women, approximately 1 in 5 is legally blind. A prospective study showed that while half the patients with pre-existing retinopathy experienced deterioration during pregnancy, all the patients had partial regression following delivery and returned to their pre pregnant state by 6 months postpartum.[13]

Studies have suggested that rapid induction of glycemic control in early pregnancy stimulates retinal vascular proliferation. However, when the entire effect of pregnancy on ophthalmologic status was considered, women with pregnancies had a slower progression of retinopathy than non pregnant women, probably because the modest deterioration in retinal status during rapid improvement in control is offset by the excellent control during the remainder of the pregnancy.[30]

Current management recommendations include baseline ophthalmology referral for pregnant patients with diabetes, with follow-up according to extent of retinopathy.

Renal function

Patients with underlying nephropathy can expect varying degrees of deterioration of renal function during a pregnancy. As renal blood flow and glomerular filtration rate increase 30-50% during pregnancy, the degree of proteinuria will also increase.[13]

The most recent studies indicate that pregnancy does not measurably alter the time course of diabetic renal disease, nor does it increase the likelihood of progression to end stage renal disease. The progression to renal disease in diabetic patients appears to be related to duration of diabetes and degree of glycemic control.[13]

Perinatal complications are increased in patients with diabetic nephropathy. Preterm birth, intrauterine growth restriction, and pre-eclampsia are all significantly more common in women with diabetic nephropathy during pregnancy.[13]

Chronic hypertension

This complicates approximately 1 in 10 diabetic pregnancies overall. Patients with underlying renal or retinal vascular disease are at a substantially higher risk, with 40% having chronic hypertension.[31] Patients with chronic hypertension and diabetes are at increased risk of intrauterine growth restriction, superimposed pre-eclampsia, abruptio placentae, and maternal stroke.[31]

Baseline renal function determination is recommended in all patients with pre-existing diabetes. Renal function tests in each trimester should be performed in individuals with overt vascular disease or who have had diabetes for more than 10 years.[13]

Pre-eclampsia

Consists of abrupt rise in blood pressure, significant proteinuria, plasma uric acid levels greater than 6 mg/dL or evidence of hemolysis, elevated liver enzymes, and low platelet count (HELLP) syndrome. Pre-eclampsia is more frequent among women with diabetes, occurring in approximately 12% as compared to 8% of the non diabetic population. The risk of pre-eclampsia is also related to maternal age and the duration of pre-existing diabetes. In patients who have chronic hypertension coexisting with diabetes, pre-eclampsia may be hard to distinguish from near-term blood pressure elevations.[13]

The rate of pre-eclampsia has been found to be related to the level of glycemic control, with fasting plasma glucose (FPG) less than 105 mg/dL, the rate of pre-eclampsia was 7.8%, if FPG was greater than 105 mg/dL, the rate of pre-eclampsia was 13.8%.[32] In this same study, pre gravida body mass index (BMI) was also significantly related to the development of pre-eclampsia.

Screening and diagnosis

Screening tests

The different screening tests used are

American Diabetes Association (ADA) procedure

ADA recommends selective screening with two step procedures.

Step 1: A 50 gm glucose challenge test (GCT) is used for screening without regard to the time of last meal or time of the day.

Step 2: If one hour GCT value is more than 140 mg/dL, 100 gm oral glucose tolerance test is recommended and plasma glucose is estimated at 0, 1, 2 and 3 hours. Gestational Diabetes Mellitus is diagnosed if any two values meet or exceed FPG > 95 mg/dL, one hour plasma glucose (PG) > 180 mg/dL, two hour PG > 155 mg/dL and three hour PG > 140 mg/dL. But major drawback of this criterion is that, the glycemic cut off was validated against the future risk of these women developing diabetes and not on the fetal outcome. And method is cumbersome as it involves screening and then diagnostic test.[33]

World Health Organization procedure (WHO)

WHO recommends universal screening with a two hour 75 gm oral glucose tolerance test (OGTT) with a threshold plasma glucose concentration of greater than or equal to 140 mg/dL at two hours similar to that of Impaired Glucose Tolerance (IGT), outside pregnancy. Carpenter himself now recommends a two hour OGTT with 75 gm glucose. The reason for this is that "when a glucose tolerance test is administered to non-pregnant individuals, it is standard to use the 75 gm, two hour OGTT.[33]

Using a different glucose challenge in pregnant versus non-pregnant patients leads to confusion in the laboratory and may result in errors in applying the proper diagnostic criteria. Further, the 75gm, two hour OGTT is in use during pregnancy in many countries, typically using the same thresholds as in non-pregnant individuals". Shortcoming with this method is that, the criteria suggested for diagnosis of GDM was also not based on maternal and fetal outcome but probably the criteria was recommended for its easy adaptability in clinical practice.[33]

International Association of Diabetes and Pregnancy Study Groups (IADPSG)[34] based on the Hyperglycemia and Adverse Pregnancy Outcome (HAPO) study[35] outcome recommends any one or more values of FPG ≥ 92 mg/dL, 1 hour PG ≥ 180 mg/dL and two hour PG ≥ 153 mg/dL for the diagnosis of GDM. The IADPSG recommendation would result in variation in the prevalence of GDM from one centre to another depending on the choice of cut-off value used, either fasting, one hour, two hour, or any two values for diagnosis. This flexibility will compromise the uniformity and likely to pose difficulty in comparing outcome data.[33]

The HAPO study[35] was performed in response to the need for internationally agreed upon diagnostic criteria for gestational diabetes, based upon their predictive value for undesirable pregnancy outcome. Increase in each of the 3 values on the 75 gm, 2-hour oral glucose tolerance test are associated with graded increase in the likelihood of pregnancy outcomes such as large for gestational age, cesarean section, fetal insulin levels, and neonatal fat content. Based upon this, the IADPSG recommends that the diagnosis of gestational diabetes mellitus be made when any of the following 75 gm, 2-hour oral glucose tolerance test thresholds are met or exceeded: fasting 92 mg/dL, 1-hour 180 mg/dL, or 2 hours 153 mg/dL. Various authoritative bodies around the world are expected to deliberate the adoption of these criteria.[33,35]

Both short term and long term morbidity in the offspring occurs at the collection point of maternal two hour plasma glucose of more than or equal to 140 mg/dL and as such this level assumes clinical significance.

DIPSI guidelines: A single test procedure to diagnose Gestational diabetes Mellitus

Seldom have a pregnant woman visiting the antenatal clinics for the first time come in the Fasting state. If she is asked to come on another day in the Fasting state she may not return. Hence, it is important to have a test that detects the glucose intolerance without the women necessarily undergoing a test in the fasting state and it is preferable to perform the diagnostic test at the first visit itself.

In the antenatal clinic a pregnant women after undergoing preliminary clinical examination, has to be given a 75 gm oral glucose load without regard to the time of

the last meal. A venous blood sample is collected at 2 hours for estimating plasma glucose. GDM is diagnosed if 2 hour plasma glucose is ≥140 mg/dL.[33]

Performing this test procedure in the non-fasting state is rational, as glucose concentrations are affected little by the time since the last meal in normal glucose tolerant women with GDM. After a meal a normal glucose tolerant women would be able to maintain euglycemia despite glucose challenge due to brisk and adequate insulin response. Whereas, a women with GDM who has impaired insulin secretion, her glycemic level increases with a meal and with glucose challenge, the glycemic excursion exaggerates further. Therefore this procedure assumes clinical relevance as WHO criteria based on glucose concentration two hour after 75 gm glucose was able to correctly identify subjects with GDM. Yet another reason for recommending the single step procedure is that, the specificity of ADA screening with 50 gm 1 hour GCT without regard to time of last meal is low. Hence, instead of performing screening test using 50 gm-1 hour test and then 100 gm OGTT, this single step procedure serves both as screening and diagnostic test for GDM is simple, economical and feasible.[33]

Advantages

- The pregnant women need not be fasting.
- Causes least disturbance in a pregnant women's routine activities.
- Serves as both screening and diagnostic procedure.

Glycosylated Haemoglobin (HbA1c) and serum fructosamine

These tests are time consuming, and are expensive with low sensitivity. International expert committee and ADA now recommends the estimation of HbA1C

(>6.5%) in the diagnosis of diabetes mellitus in general population but for the screening of GDM, studies are underway. Serum fructosamine levels indicate glycemic control over a shorter period, but are not indicated for diagnosis of GDM.[36,37]

Glycosuria

This test is affected by numerous physiological factors and has only 30% sensitivity.[38]

ADA and WHO criteria for the diagnosis of GDM[39]

	ADA 100 gm OGTT	ADA 75 gm OGTT	WHO 75 gm OGTT
Fasting (mg/dL)	95	95	126
1 hour (mg/dL)	180	180	-
2 hour (mg/dL)	155	155	140
3 hour (mg/dL)	140	-	-

For the ADA criteria, two or more of the values form either the 100 or 75 gm OGTT must be met or exceeded to make the diagnosis of GDM. For the WHO criteria, one of the two values from the 75 gm OGTT must be met or exceeded to make the diagnosis of GDM.

Timing of screening for GDM

An increase in beta cell mass and insulin secretion in the fetus occurs by the early week of gestation, in response to maternal hyperglycemia.[40]

The priming of the fetal beta cells may account for the persistence of fetal hyperinsulinaemia throughout pregnancy and risk of accelerated fetal growth, even when the mother enjoys good metabolic control in later pregnancy.[3] This necessitates performing the test procedures to diagnose GDM in the early weeks of gestation itself. [30, 41]

This indicates the need for performing the test procedures to diagnose GDM in the first trimester itself. Further, early detection and care results in a better fetal outcome.[42]

By following this usual recommendation for screening between 24 and 28 weeks of gestation, the possibility of detecting unrecognized type 2 diabetes before pregnancy (pre GDM) is likely to be missed. If the two hour PG> 200 mg/dL in the early weeks of pregnancy, she may be a pre- GDM and HbA1c > 6 is confirmatory (normal A1c levels during pregnancy is 5.3-6).[42]

A pregnant women found to have normal glucose tolerance (NGT) in the first trimester, should be tested for GDM around 24^{th}- 28^{th} weeks and again around 32^{nd}-34^{th} weeks and also later weeks if necessary, mainly when rapid maternal weight gain occurs or fetal macrosomia is suspected.[42]

Literature

A cross sectional study was done to investigate the trend in prevalence of GDM in Guntur (South India) during August 2012 to August 2013 by using DIPSI method. A total 200 pregnant women participated in this study. GDM was diagnosed in 5 (2.5%). GDM was more common in the age group of 28 ±3.57 years in antenatal women with higher parity and family history of diabetes. Of those testing positive,

20% of women had no risk factors for GDM and 80% had more than one risk factor for GDM. Family history of diabetes, past history of fetal loss, obesity, age>30 years were statistically more common in GDM population compared to normal population.[43]

A prospective institutional study was conducted to determine the incidence of GDM in pregnant women in rural settings of Hyderabad, South India by using DIPSI method during April 2011 to March 2012. A total 400 pregnant women participated in this study. The incidence of GDM was 5.7 % using the DIPSI method. GDM was observed more frequently in age ≥25years (34.8%), BMI ≥25 (39.1%), past history of GDM (4.3%), family history (13%), history of previous pregnancy loss (8.7%), and history of polyhydramnios (8.7%). The fetal and maternal outcomes in GDM were: anencephaly (4.3%), gestational hypertension (8.7%), macrosomia (13.0%) and preterm delivery (17.4%).[44]

A cross sectional study was conducted in Jammu (North India), to determine the prevalence and outcome of GDM using DIPSI criteria during December 2007 to November 2008. Prevalence of GDM was 6.94%. The maternal and fetal outcome such as Cesarean section, preterm delivery, macrosomia and shoulder dystocia were significantly higher among the GDM group than non GDM group.[45]

A community based cross sectional study was conducted in Chennai, South India to find out the prevalence between April 2009 and February 2010 among pregnant women. A total 1463 pregnant women was participated in the study. The proportion of GDM was completed based on IADPSG and DIPSI criteria. The prevalence of GDM was 14.6% (n=214) by IADPSG criteria and 13.4% (n=196) by DIPSI criteria.[46]

A cross sectional institutional based study was undertaken in Ahmedabad using DIPSI method to know the prevalence of GDM in urban population of India. 232 women screened, overall 32 (13.79%) women found to have GDM. Risk factor like higher BMI was significantly associated with GDM.[47]

A cross sectional study was done in Western Rajasthan to determine the prevalence of GDM and to assess its feto-maternal risk factors. 500 pregnant women participated in study, the overall prevalence of GDM was 6.6% assessed using DIPSI method. Maternal and fetal complication in the GDM group was much higher than in the non GDM group.[1]

A community based cross sectional study was conducted in urban block of Kashmir (North India) which prospectively screened pregnant women for GDM using DIPSI guidelines during April 2011 to March 2012. A total 306 women were registered for the study. The prevalence rate of GDM was 7.8%. The study also found significant increase in prevalence of GDM with parity, gravida status and history of diabetes.[7]

A cross sectional institutional based study was conducted in Ghaziabad (Uttar Pradesh) to compare the accuracy measure of random blood glucose test and DIPSI recommended glucose challenge test as screening for GDM and to study the prevalence of GDM and associated risk factors. A total 576 pregnant women participated in the study. The area under Receiver Operating Characterstic (ROC) curve was larger for DIPSI than random glucose test. GDM was present in 8.9% women which were confirmed by DIPSI method. There was a significant difference in the area under the curve of the two tests which is in favor of DIPSI recommended

method. Age ≥30 years, BMI ≥25 and family history of diabetes were found to be risk factors of GDM.[48]

A cross sectional study was done among 200 rural pregnant women in Andhra Pradesh, India to find out the prevalence of GDM by using DIPSI criteria and ADA criteria. 22 (11%) was found GDM by using DIPSI method and 5 (2.5%) by using ADA criteria. This study has demonstrated that DIPSI method was able to accurately detect GDM and has a higher sensitivity.[49]

A prospective study was done at 198 health care facilities in Kanpur (Uttar Pradesh) during September 2012 to October 2014. 24,656 pregnant women were screened as per guidelines of DIPSI, to determine the prevalence of GDM and evaluate the maternal and fetal outcome in and around Kanpur city. Prevalence of GDM was 14.42%. Still birth, perinatal neonatal mortality was higher in GDM compare to non GDM. GDM positive cases had 20.6% positive family history of diabetes.[50]

A prospective cohort study conducted during September 2008 to January 2011 in Cuttack (Orissa), to determine the prevalence and risk factors of GDM. 500 pregnant women were screened by using DIPSI method. 26 (5.2%) were diagnosed GDM. GDM were more significant in obese, family history of diabetes and in multigravida. Fetal outcome like macrosomia, shoulder dystocia, still birth, hypoglycemia, congenital anomalies, trauma during delivery were all found to be more in women with GDM. In this study rise in prevalence of GDM associated with increase risk of pregnancy and delivery complication.[51]

METHODOLOGY

STUDY SETTING

The study was conducted in three Urban Health Centres (UHCs), Ashok Nagar, Ram Nagar and Rukmini Nagar, which are urban field practice area of Jawaharlal Nehru Medical College, Belagavi. Data was collected from 360 pregnant women attending the antenatal clinic of three UHCs.

STUDY DESIGN

A cross-sectional study.

STUDY PERIOD

The study was conducted over a period of one year from 1st January to 31st December 2014.

STUDY POPULATION

Pregnant women attending Antenatal Clinic at three Urban Health Centres Ashok Nagar, Ram Nagar and Rukmini Nagar.

INCLUSION CRITERIA

All Pregnant women attending Antenatal Clinic of three UHCs irrespective of period of gestation.

EXCLUSION CRITERIA

All pregnant women with:

- History of pre-gestational diabetes mellitus
- History of cardiac disease, liver disease, renal disease, tuberculosis

SAMPLE SIZE

The sample size was calculated using the formula:-

n $= Z_{\alpha}^{2} \times p\ q / d^2$

$= 1.96 \times 1.96 \times p\ q / d^2$

where, p = prevalence of GDM = 18% [52]

q = 100 - p = 100-18 = 82%

d = absolute error = 4%

So, $n = 1.96 \times 1.96 \times 18 \times 82 / 4^2$ $= 354 \approx 360$

Hence, 360 pregnant women were chosen for the study.

SAMPLING METHOD

The sampling method adopted was systematic random sampling. An average 700 cases attended Antenatal Clinics of Ram Nagar and Ashok Nagar UHCs each and 1000 cases at Rukmini Nagar (considering previous three years data). The total study sample of 360 cases was collected from each of these centres in the ratio 3:3:4. Thus 110 cases from Ram Nagar (every 6^{th} antenatal case), 110 cases from Ashok Nagar (every 6^{th} antenatal case), 140 cases from Rukmini Nagar (every 7^{th} antenatal case) were taken.

METHOD OF DATA COLLECTION

Pregnant women attending antenatal clinic of three UHCs were informed about the nature of study. After obtaining written informed consent**,** a pretested questionnaire was used to collect information regarding socio-demographic details,

risk factors, educational status, occupational status, income and habits. Further they were clinically examined and anthropometry measurements such as height, weight and other details were collected.

Following were considered as high risk factors[11] included in the questionnaire assessment for GDM

- GDM during previous pregnancy
- Family history of Diabetes
- Large weight babies born from a previous pregnancy (macrosomia ≥ 4000 g).
- Baby born from a previous pregnancy showing any complications known to be associated as arising from maternal GDM
- History of abortion or stillbirth during previous pregnancy.
- Obesity
- Parity (multigravida).
- Age ≥30 years.

DIPSI method was used to diagnose GDM.[8]

STATISTICAL ANALYSIS

Data was entered in Excel sheet after coding. Statistical Package for Social Sciences (SPSS) version 16.0 software was used for analysis of the data. Numerical variables were analysed as means and standard deviations. Categorical data regarding socio-demographic factors and prevalence of various factors, including prevalence of GDM were summarized using percentages. Chi-square test was used to compare find the association between various study variables and the prevalence of GDM. Fisher's

Exact Test was used wherever applicable. A probability value (p value) of less than 0.05 was considered as significant.

ETHICAL CLEARANCE

Ethical clearance was obtained from the Institutional Review Board of Jawaharlal Nehru Medical College, Belagavi. Informed consent was taken from all the participants. (Annexure I)

DEFINITION OF STUDY VARIABLES

1. **Age**

   Age was recorded to the nearest completed year as per information given by the study subjects

2. **Education status**

   a. Illiterate – Never attended school

   b. Primary school – Having studied up to 7^{th} standard

   c. High school – Having studied at least until 8^{th} standard but not beyond 10^{th} standard

   d. PUC – Having studied at least until 10^{th} standard but not beyond 12^{th} standard

   e. Graduation – Having studied beyond 12^{th} standard

3. **Type of Family**[53]

   a. Joint family: It consists of number of married couples and their children who live in the same household.

   b. Nuclear family: The family consisting of married couple along with their dependent children.

4. Socio-economic status:

Per capita income was classified using Modified B G Prasad's classification.[54]

Social class	Prasad's classification 1961 (per capita income in Rupees/month)	Modified Prasad's classification in study period 2014 (per capita income in Rupees/month)
I	100 and above	5571 and above
II	50 – 99	2786 – 5570
III	30 – 49	1671 – 2785
IV	15 – 29	836 – 1670
V	<15	Below 836

Modification was done with the aid of multiplication factor (MF), which was obtained as below:

$$MF = \frac{\text{Value of consumer price index average for the study period (2014)}}{100} \times 4.93$$

$$= 1130 / 100 \times 4.93 = 55.71$$

As our study period was from 1st January to 31st December 2014, the mean consumer price index for the period was considered. Average consumer price index for year 2014 was 1130.

5. Period of gestation

a) First 12 weeks – First trimester

b) 13 – 28 weeks – Second trimester

c) 29 – 40 weeks – Third trimester

6. Gravida

a) Primigravida – Woman who is pregnant for the first time.

b) Multigravida – Woman who has previously been pregnant.

7. Macrosomia[55]

Delivering a baby weighing more than 4000 gm irrespective of the gestational age.

8. Physical exercise[56]

Physical activity was assessed by three domains: Sufficient, Insufficient and Nil

a. Sufficient: ≥150 minute accumulated MVPA (Moderate Vigorous Physical Activity) per week
b. Insufficient: 1–149 minute accumulated MVPA per week
c. Nil: Zero minute accumulated MVPA per week

9. Height:

The subject was asked to stand straight without footwear, with heels, buttocks and back straight touching the wall and arms hanging by side. The height was measured from head to heal. The coinciding reading was measured to the nearest cm using a measuring tape.[57]

11. Weight:

Body weight was measured without any foot wear and with minimal clothing to the nearest 0.1 kilogram using a standard portable adult weighing machine, which was standardized periodically during the study. The scale was adjusted to zero before each session and weight was recorded in kilograms.[57]

12. Calculation of Body Mass Index (BMI in Kg/m^2): Body mass index was calculated as;

BMI = Weight (Kg) / Height (Meter^2)

BMI is classified for Asians as:[58]

BMI	Status
<18.5	Under weight
18.5 to 22.9	Normal
23 to 24.9	Over weight
≥25	Obese

13. Blood Pressure

Blood pressure measurement: During the course of interview, three measurements of blood pressure of each study participant were measured using mercury sphygmomanometer at an interval of 5 minutes in sitting position. The reading of blood pressure was obtained after the subject had rested for at least five minutes in the seated position. The first blood pressure measurement was recorded after obtaining

socio-demographic information from study subject, while second and third was recorded during clinical examination.

All blood pressure measurements were made on left arm of each subject, using a adult cuff of appropriate size covering 80% of the arm. The sphygmomanometer was kept at the level of the heart. The average of last two Systolic Blood Pressure and Diastolic Blood Pressure reading in mm Hg were noted to describe the blood pressure of the participant.[59]

14. DIPSI criteria

In this procedure after undergoing preliminary examination, a pregnant woman was given 75gm of oral glucose load, irrespective of whether she was in fasting or non fasting state and without regard to time of last meal. Venous blood sample was collected at 2-hours for estimating plasma glucose under aseptic precautions. The blood sample was collected in Sodium Fluoride bulb and sent to laboratory of Biochemistry department of J. N. Medical College, Belagavi. GDM was diagnosed if 2-hours plasma glucose is ≥ 140mg/dl. If found negative at this time, she was advised to undergo screening test again around 24-28 weeks and finally around 30-34 weeks.[8]

RESULTS

The present study was conducted in three Urban Health Centres, Ramnagar, Ashoknagar and Rukmininagar, Belagavi which are field practice areas of Department of Community Medicine, Jawaharlal Nehru Medical College Belagavi.

The data obtained was tabulated and analyzed under following headings:

1. Socio-demographic profile of study participants

2. Prevalence and risk factors affecting GDM

3. Univariate analysis of risk factors of GDM

4. Multivariate analysis of risk factors of GDM

1. SOCIO-DEMOGRAPHIC PROFILE OF STUDY PARTICIPANTS

Table 1: Distribution of study subjects according to age group

Age group in years	No.	%
≤ 19	37	10.3
20-24	170	47.2
25-29	101	28.1
≥ 30	52	14.4
Total	**360**	**100**

Of the 360 pregnant women who participated in the study, 37 (10.3%) were in the age group of ≤ 19 years, 170 (47.2%) were in the age group of 20-24 years, 101 (28.1%) were in the age group of 25-29 years and 52 (14.4%) were in ≥ 30 years age group.

Mean age group of the study participants was 24.3±3.92 years. Range was 18-37 years.

Graph 1: Distribution of study subjects according to age group

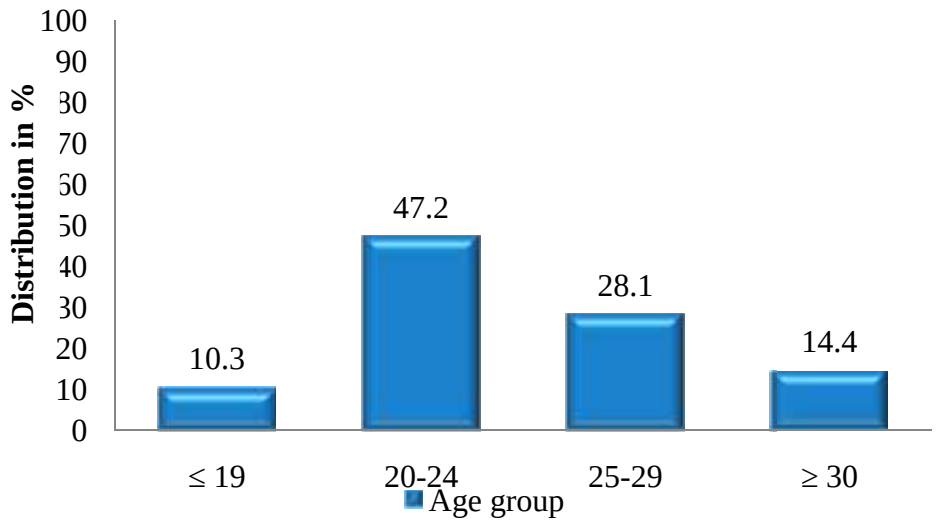

Table 2: Distribution of study subjects according to Religion

Religion	No.	%
Hindu	163	45.3
Muslim	197	54.7
Total	**360**	**100**

Out of 360 study participants, 163 (45.3%) were Hindus, 197 (54.7%) were Muslims.

Table 3: Distribution of study subjects according to educational status

Educational status	No.	%
Illiterate	19	5.3
Primary school	63	17.5
High school	136	37.8
PUC	104	28.9
Graduation	38	10.5
Total	**360**	**100**

In the present study, 19 (5.3%) were found to be illiterate, 63 (17.5%) had primary school education, 136 (37.8%) had high school education, 104 (28.9%) had PUC school education and 38 (10.5%) were graduated.

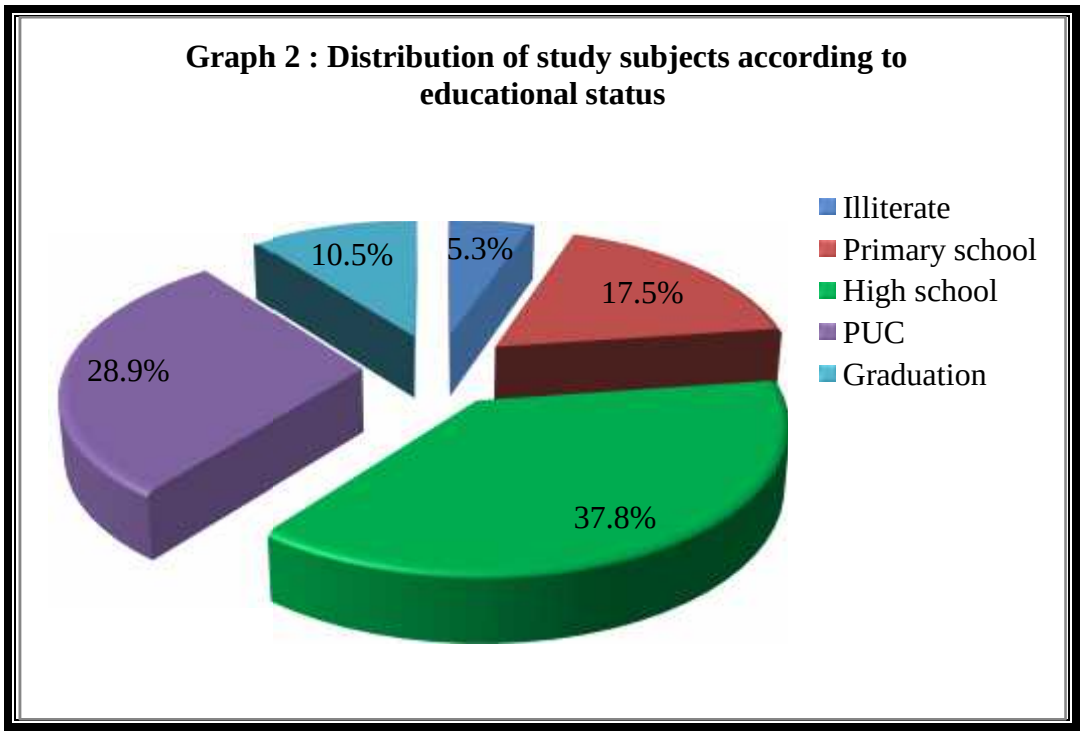

Table 4: Distribution of study subjects according to occupation

Occupation	No.	%
Working	17	4.7
Housewife	343	95.3
Total	**360**	**100**

Out of 360 pregnant women, 17 (4.7%) were working and majority 343 (95.3%) were housewives.

Table 5: Distribution of study subjects according to type of family

Family type	No.	%
Joint	236	65.6
Nuclear	124	34.4
Total	**360**	**100**

Out of 360 study subjects, 236 (65.6%) belonged to joint family and 124 (34.4%) were from nuclear family.

Table 6: Distribution of study subjects according to socio economic status (Modified B. G. Prasad classification)

Socio Economic Status	No.	%
Class I	36	10
Class II	44	12.2
Class III	128	35.6
Class IV	98	27.2
Class V	54	15
Total	**360**	**100**

In the present study, 36 (10%) belonged to class I, 44 (12.2%) to class II; 128 (35.6%) to class III, 98 (27.2%) to class IV and 54 (15%) belonged to class V.

Graph 3 : Distribution of study subjects according to socio economic status (Modified B. G. Prasad classification)

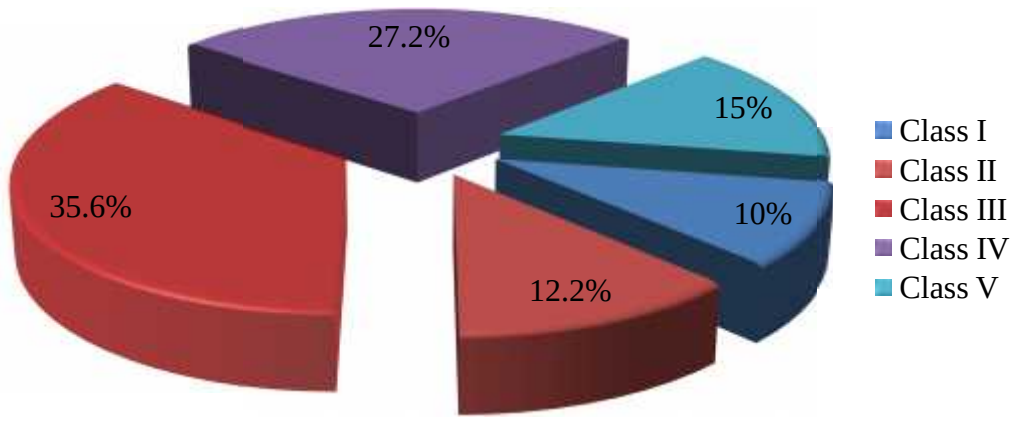

Table 7: Distribution of study subjects according to period of gestation.

Period of gestation	No.	%
First trimester	82	22.7
Second trimester	173	48.1
Third trimester	105	29.2
Total	**360**	**100**

Out of 360 study participants, 82 (22.7%) were in first trimester of gestation, 173 (48.1%) in second trimester and 105 (29.2%) of the subjects in third trimester.

Table 8: Distribution of study subjects according to gravida.

Gravida	No.	%
Primigravida	168	46.7
Multigravida	192	53.3
Total	**360**	**100**

In the present study, 168 (46.7%) were primigravida and 192 (53.3%) were multigravida.

Table 9: Distribution of pregnant women according to previous history of abortion.

Previous history of abortion	No.	%
Yes	55	15.2
No	137	38.1
Not applicable (Primigravida)	168	46.7
Total	**360**	**100**

In the present study, 55 (15.2%) were having previous history of abortion, 137 (38.1%) were not have previous history of abortion and 168 (46.7%) were not applicable to ask history of abortion because they were primigravida.

Table 10: Distribution of study subjects according to previous history of GDM.

Previous history of GDM	No.	%
Yes	4	1.1
No	188	52.2
Not applicable (Primigravida)	168	46.7
Total	**360**	**100**

Out of 360 pregnant women, 4 (1.1%) had previous history of GDM and 188 (52.2%) had no previous history of GDM.

Table 11: Distribution of study subjects according to past history of macrosomia.

Past history of macrosomia	No.	%
Yes	6	1.6
No	186	51.7
Not applicable (Primigravida)	168	46.7
Total	**360**	**100**

In the present study, among 360 pregnant women only 6 (1.6%) had given the past history of macrosomia and 186 (51.7%) had no past history of macrosomia.

Table 12: Distribution of study subjects past history of LSCS (Lower segment caesarean section)

Past history of LSCS	No.	%
Yes	58	16.1
No	134	37.2
Not applicable (Primigravida)	168	46.7
Total	**360**	**100**

In our study, out of 360 pregnant women, 58 (16.1%) had past history of LSCS and 134 (37.22%) were not having history of LSCS.

Table 13: Distribution of study subjects according to family history of diabetes.

Family history of diabetes	No.	%
Yes	105	29.2
No	255	70.8
Total	**360**	**100**

In the present study, majority 255 (70.8%) of the study subjects did not have family history of diabetes, only 105 (29.2%) had family history of diabetes.

Table 14: Distribution of study subjects according to history of use of tobacco before this pregnancy.

History of use of tobacco before this pregnancy	No.	%
Yes	43	11.9
No	317	88.1
Total	**360**	**100**

Out of 360 study subjects, only 43 (11.9%) had history of tobacco consumption before this pregnancy and 317 (88.1%) did not have any history of tobacco use.

Table15: Distribution of study subjects according to physical activity

Physical activity	No.	%
Sufficient	96	26.7
Insufficient	126	35
Nil	138	38.3
Total	**360**	**100**

In the present study, 96 (26.7%) of the pregnant women had sufficient physical activity, 126 (35%) had insufficient and 138 (38.3%) had not done any physical activity.

Table16: Distribution of study subjects according to diet pattern

Diet pattern	No.	%
Vegetarian	168	46.7
Non vegetarian	192	53.3
Total	**360**	**100**

In the present study, 168 (46.7%) of the pregnant women were found to be consuming vegetarian diet and 192 (53.3%) were having non vegetarian diet.

Blood Pressure

The mean systolic blood pressure of study participants was 121.9±9.33 and the range was 108-150mm/Hg. The mean diastolic blood pressure of study participants was 76.9±6.68 and the range was 68-90mm/Hg.

Table 17: Distribution of study subjects according to BMI

BMI Categories (Kg/m^2)	No.	%
Underweight (<18.5)	21	5.8
Normal (18.5 to 22.9)	186	51.7
Overweight (23 to 24.9)	85	23.6
Obese (≥25)	68	18.9
Total	**360**	**100**

In the present study, majority of pregnant women 186 (51.7%) had normal BMI, 85 (23.6%) were overweight, 68 (18.9%) were obese and only 21(5.8%) were underweight.

Mean BMI of the study participants was 22.48±3.05 kg/m^2. Range was 16.82-34.89kg/m^2.

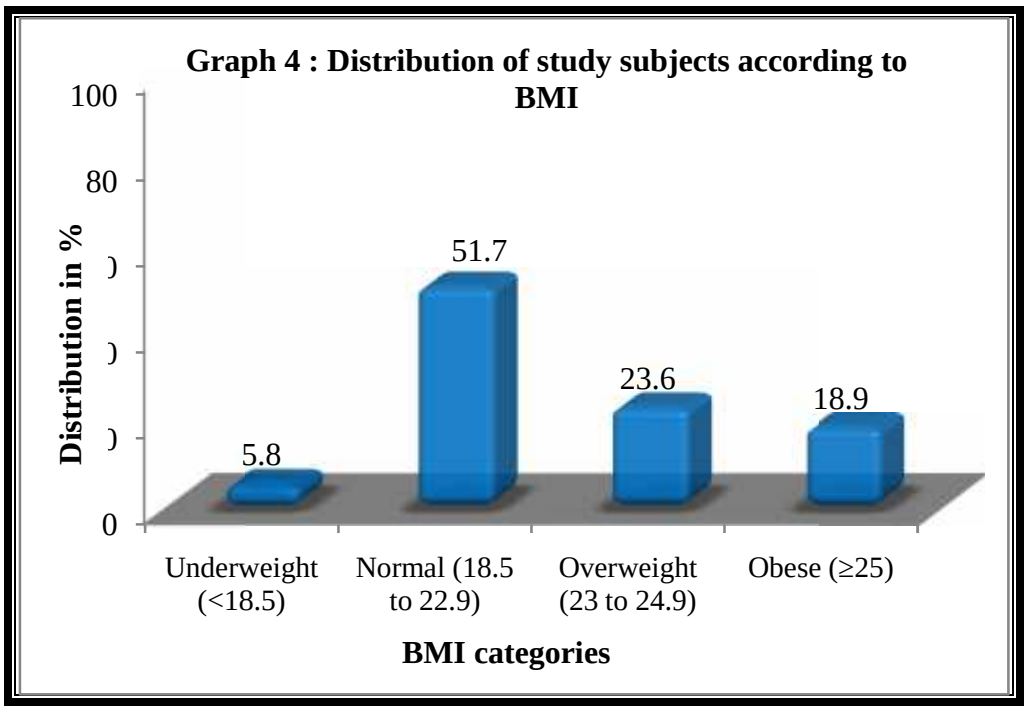

Table 18: Prevalence of GDM based on DIPSI criteria.

Gestational diabetes mellitus	No.	%
Present	44	12.2
Absent	316	87.8
Total	**360**	**100**

In the present study the prevalence of GDM according to DIPSI criteria was 12.2%.

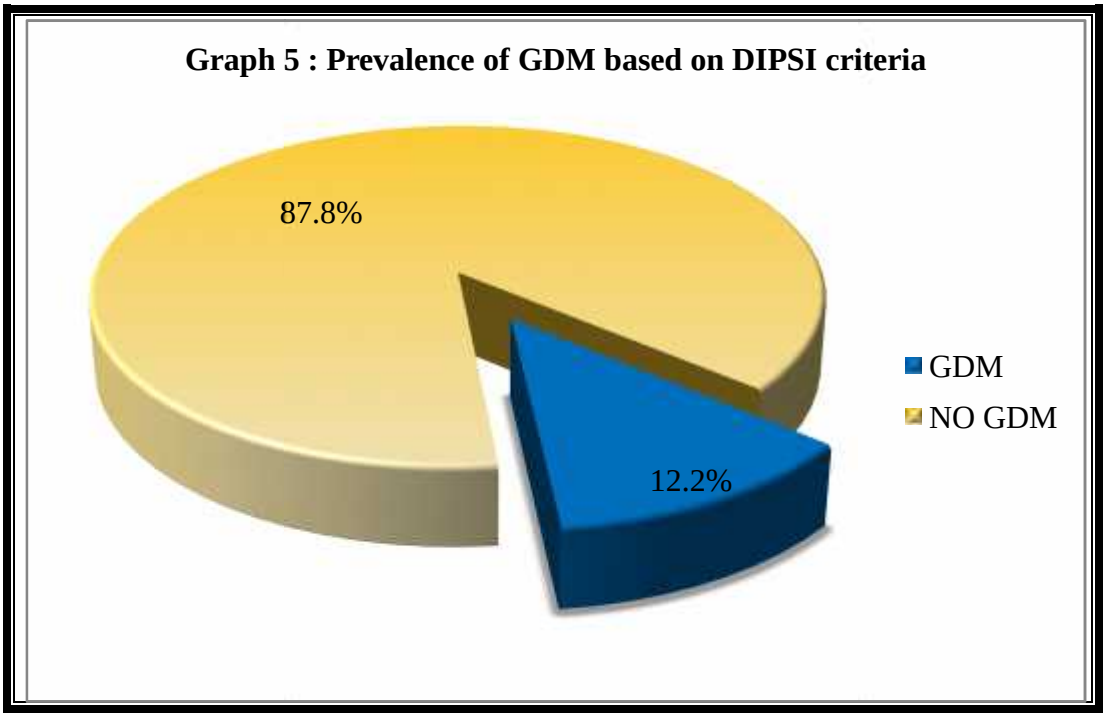

Table 19: Prevalence of GDM according to age.

Age group (years)	Pregnant women	GDM cases	%
≤ 19	37	1	2.7
20-24	170	20	11.8
25-29	101	11	10.9
≥ 30	52	12	23.1
Total	**360**	**44**	**12.2**
χ^2 = 9.036	**Df = 3**	**p = 0.029**	

In this study, overall 44 (12.2%) pregnant women were found to have GDM. Age specific prevalence was found to be higher in age ≥30 years 12 (23.1%) whereas among the women in the age group of ≤19 years only 1 (2.7%) was having GDM. And age group 20-24 years were having 20 (11.8 %) and 25-29 years were having 11 (10.9%) of prevalence. The prevalence of GDM among the age groups showed statistically significant difference (p=0.029). The trends of prevalence of GDM increased as age increased which was found to be statistically significant (χ^2 for trends = 6.299, p=0.012).

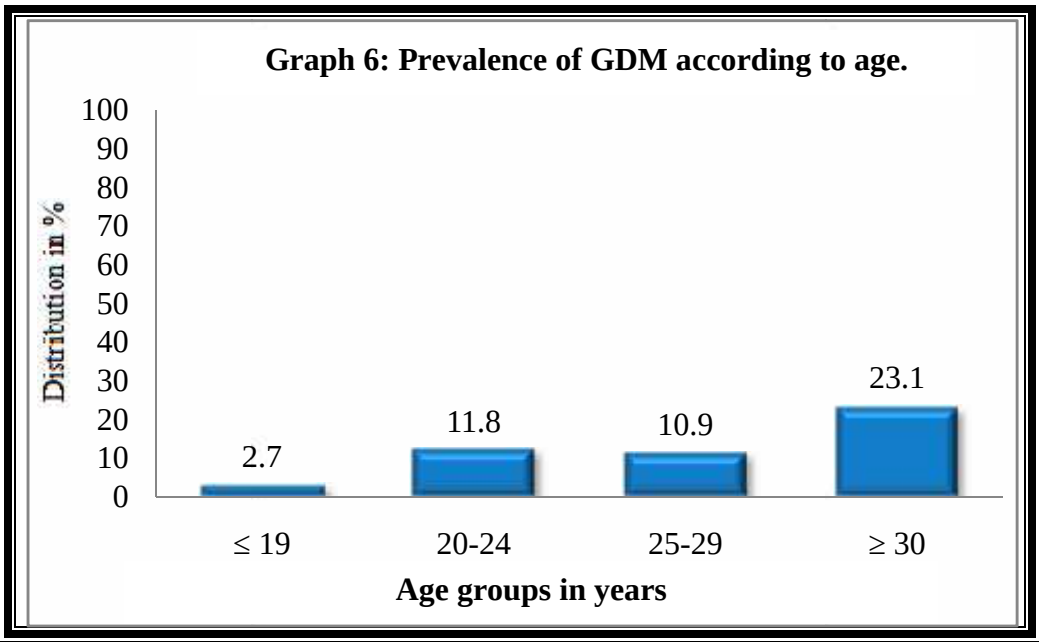

Table 20: Prevalence of GDM according to socio economic status

Socio economic class	Pregnant women	GDM cases	%
I	36	5	13.9
II	44	12	27.3
III	128	13	10.2
IV	98	10	10.2
V	54	4	7.4
Total	**360**	**44**	**12.2**
χ^2 = 11.431	**Df = 4**	**p = 0.022**	

In the present study 12 (27.3%) of prevalence of GDM was found in socio economic class II and only 4 (7.4%) prevalence was found in class V. The association between socio economic status with GDM showed significant difference (p=0.022). The trends of prevalence of GDM decreased as socio economic status decreased which was found to be statistically significant (χ^2 for trends = 4.362, p=0.03).

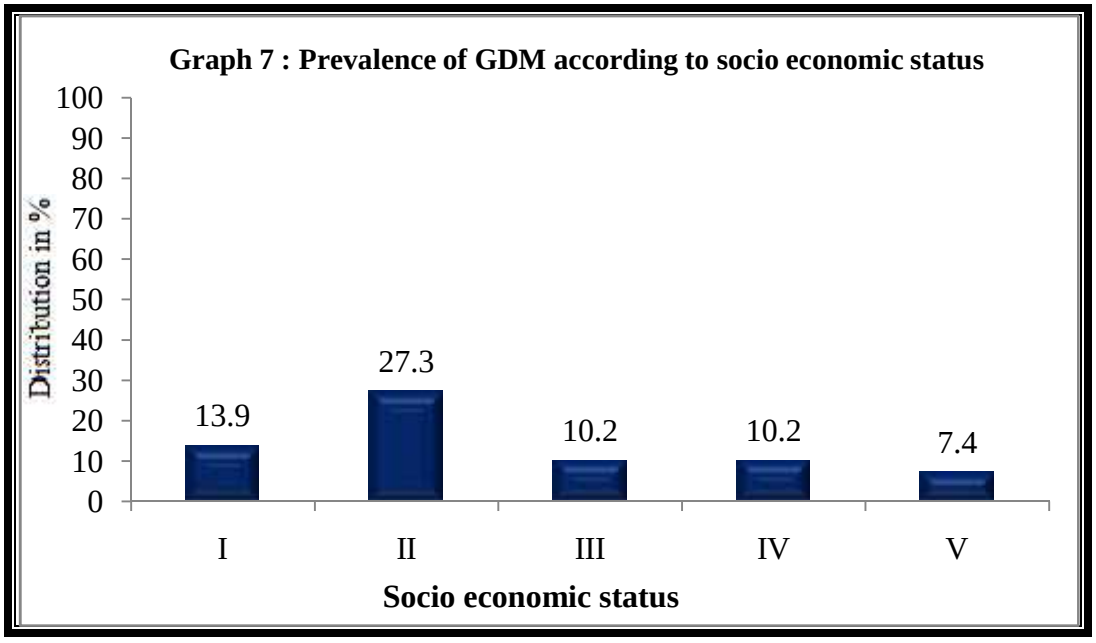

Table 21: Prevalence of GDM according to education status

Education	Pregnant women	GDM cases	%
Illiterate	19	0	0
Primary school	63	10	15.9
High school	136	18	13.2
PUC	104	10	9.6
Graduation	38	6	15.8
Total	**360**	**44**	**12.2**
$\chi^2 = 4.658$	**Df = 4**	**p = 0.323**	

In the present study the prevalence of GDM was higher in graduated and primary school educated pregnant women 15.9% respectively. However this difference was not found to be statistically significant (p=0.323)

Table 22: Prevalence of GDM according to occupation

Occupation	Pregnant women	GDM cases	%
Working	17	3	17.6
Housewife	343	41	12
Total	**360**	**44**	**12.2**
$\chi^2 = 0.103$	**Df = 1**	**p = 0.749**	

In the present study the prevalence of GDM was 3 (17.6%) in working women and 41 (12%) in housewives. This difference was not statistically significant (p=0.749).

Table 23: Prevalence of GDM according to period of gestation

Trimester	Pregnant women	GDM cases	%
First	82	7	8.5
Second	173	19	11.9
Third	105	18	17.1
Total	**360**	**44**	**12.2**
$\chi^2 = 3.656$	**Df = 2**	**p = 0.161**	

In the present study, the prevalence of GDM was 18 (17.1%) in third trimester. In second trimester the prevalence of GDM was 19 (11.9%) and 7 (8.5%) in first trimester respectively. This difference was not statistically significant (p = 0.161).

Table 24: Prevalence of GDM according to gravida.

Gravida	Pregnant women	GDM cases	%
Primigravida	168	11	6.5
Mutigravida	192	33	17.2
Total	**360**	**44**	**12.2**
χ^2 = 9.455	**Df = 1**	**p = 0.002**	

Among the pregnant women, 11 (6.5%) of primigravida and 33 (17.2%) of multigravida had GDM. The prevalence of GDM increased with multigravida and this shows that the severity of gestational diabetes mellitus increases with gravidity which is found to be statistically significant (p=0.002)

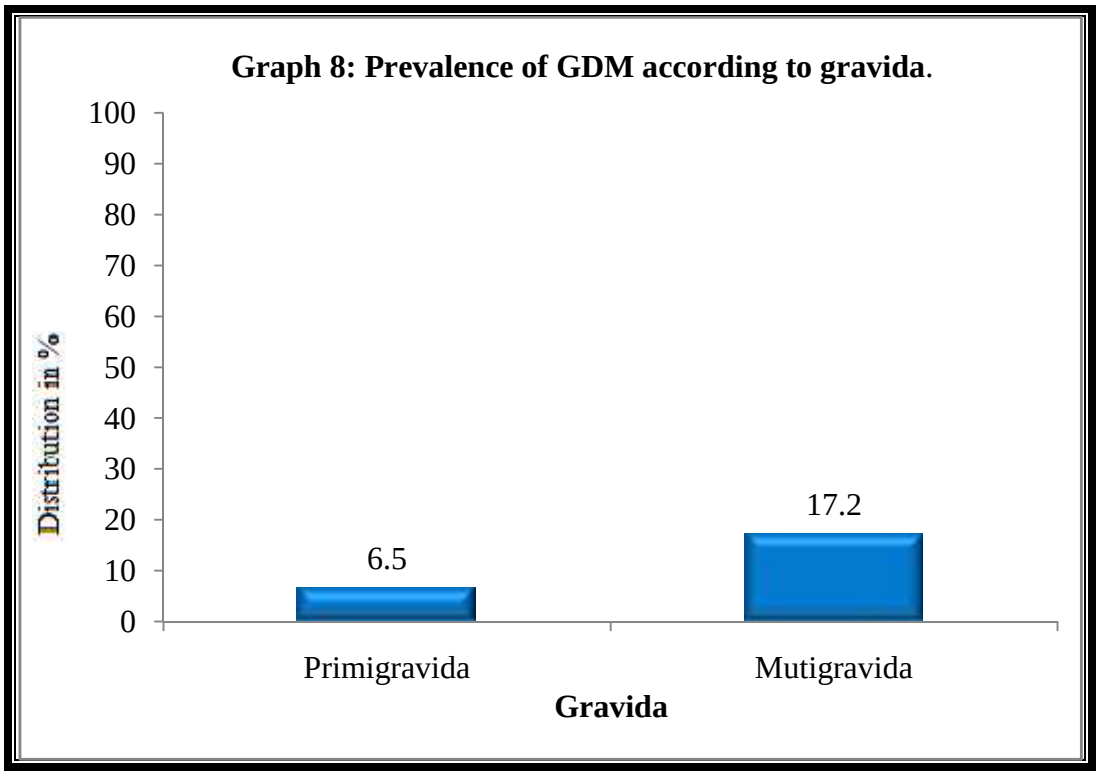

Table 25: Prevalence of GDM according to previous history of abortion.

Abortion	Pregnant women	GDM cases	%
Yes	55	15	27.3
No	137	18	13.1
Not applicable (Primigravida)	168	11	6.5
Total	**360**	**44**	**12.2**
χ^2 = 16.762	**Df = 2**	**p <0.0010**	

Among study participants who were having the previous history of abortion the prevalence of GDM was much higher 15 (27.3%) than those did not have GDM 18 (13.1%). This difference was statistically significant when compared with the risk categories (p<0.0010).

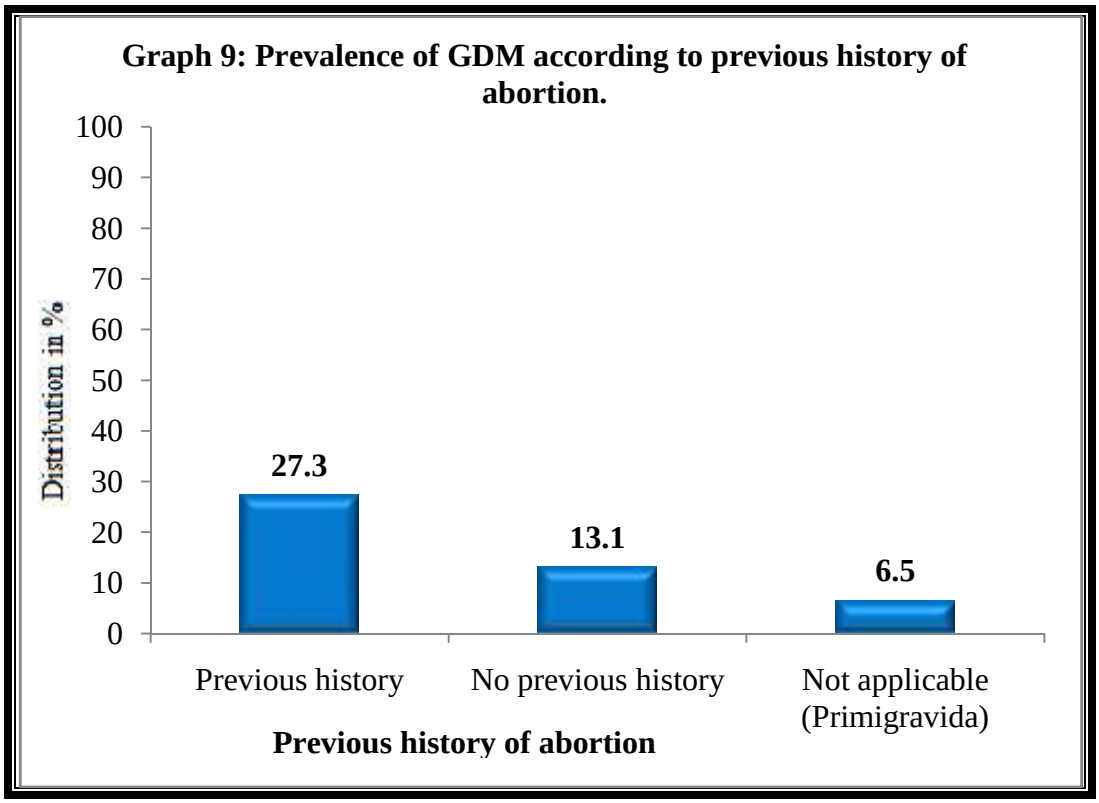

Table 26. Prevalence of GDM according to previous history of GDM.

Previous h/o GDM	Pregnant women	GDM cases	%
Yes	4	2	50
No	188	31	16.5
Not applicable (Primigravida)	168	11	6.5
Total	**360**	**44**	**12.2**
Fisher's exact test p<0.001			

In this present study prevalence of GDM was higher in those who were having the previous history of GDM 2 (50%). This difference was statistically significant (p<0.001).

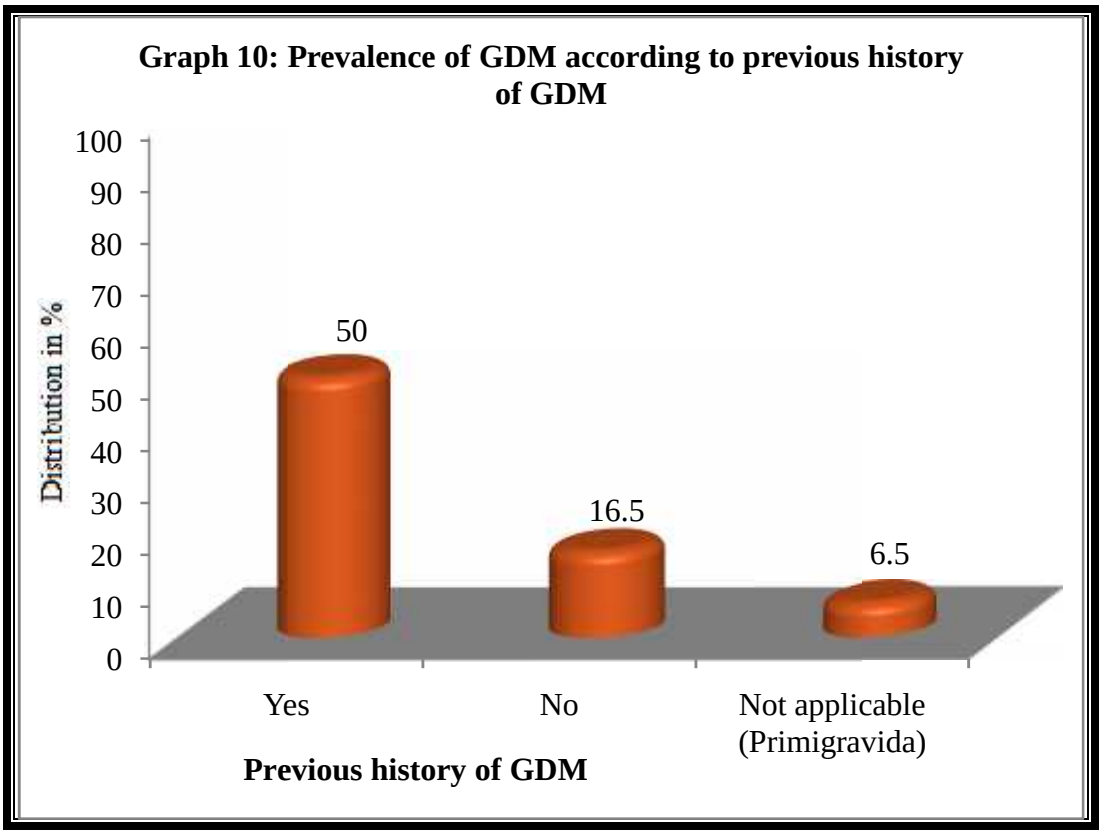

Table 27: Prevalence of GDM according to previous history of macrosomia.

History of macrosomia	Pregnant women	GDM cases	%
Yes	6	2	33.3
No	186	31	16.7
Not applicable (Primigravida)	168	11	6.5
Total	**360**	**44**	**12.2**
Fisher's Exact test		**p = 0.003**	

In the present study those pregnant women who were having the previous history of macrosomia, the prevalence of GDM was 2 (33.3%) and 31 (16.7%) in those who did not have previous history of macrosomia. This difference was statistically significant (p=0.003).

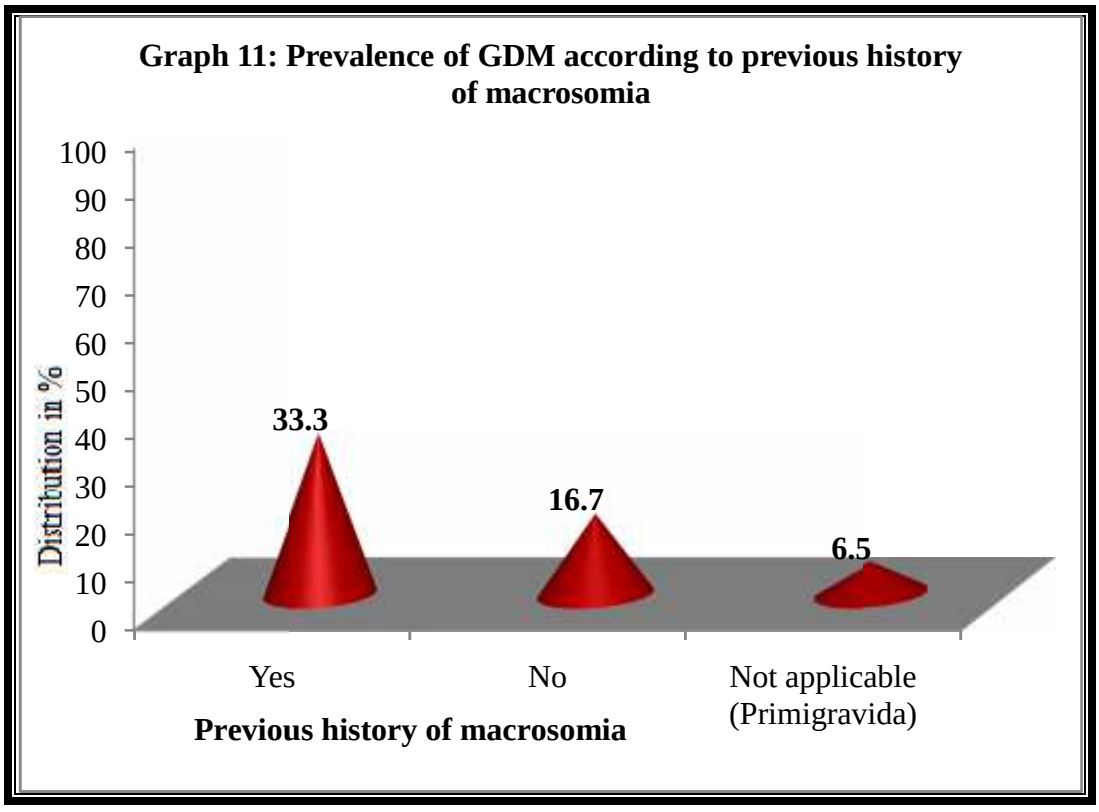

Table 28. Prevalence of GDM according to previous history of LSCS

Previous h/o LSCS	Pregnant women	GDM cases	%
Yes	58	13	22.4
No	134	20	14.9
Not applicable (Primigravida)	168	11	6.5
Total	**360**	**44**	**12.2**
χ^2 = 11.570	**Df = 2**	**p = 0.003**	

Among 360 pregnant women, prevalence of GDM was 13 (22.4%) in those who had previous history of LSCS and only 20 (14.9%) in those who did not have previous history of LSCS. This difference was statistically significant (p = 0.003).

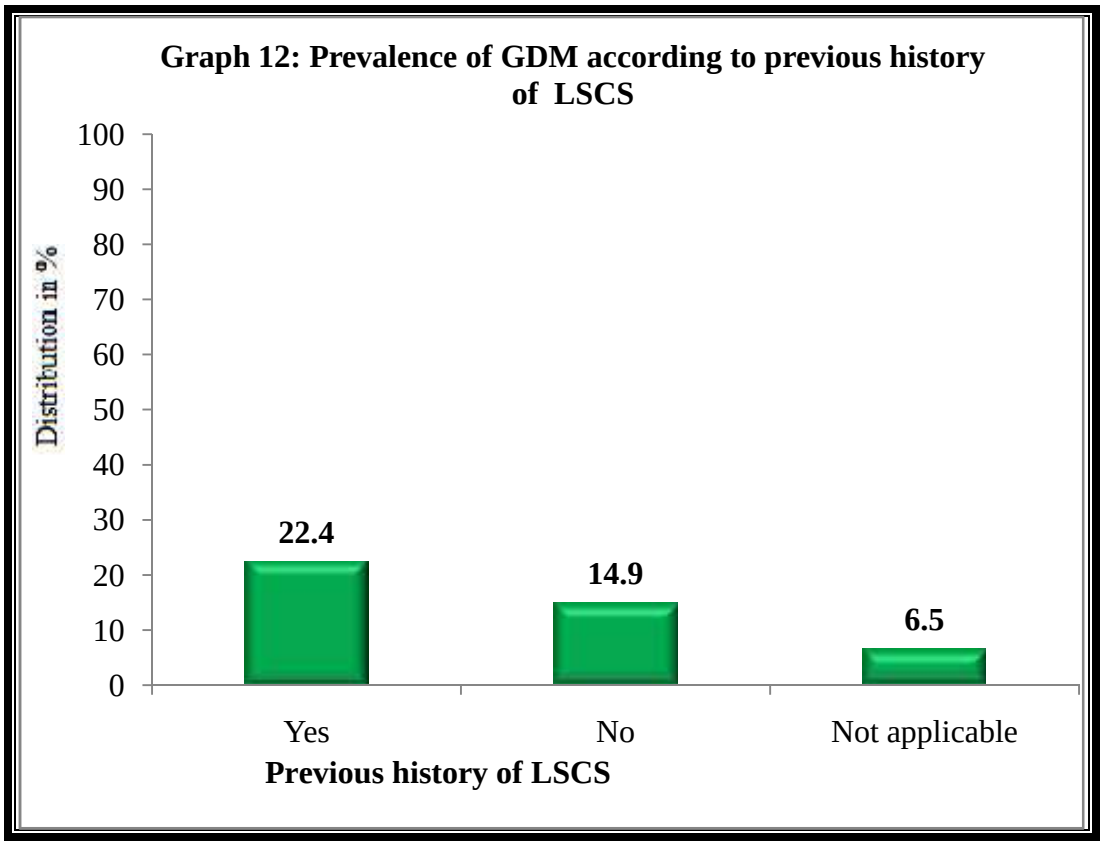

Table 29: Prevalence of GDM according to family history of diabetes.

Family history of diabetes	Pregnant women	GDM cases	%
Yes	105	26	24.8
No	255	18	7.1
Total	**360**	**44**	**12.2**
χ^2 = 21.727	**Df = 1**	**p <0.001**	

\ In the present study the prevalence of GDM was 26 (24.8%) in those pregnant women who had family history of diabetes and 18 (7.1%) in those pregnant women who did not have the family history of diabetes. This difference was statistically significant (p<0.001).

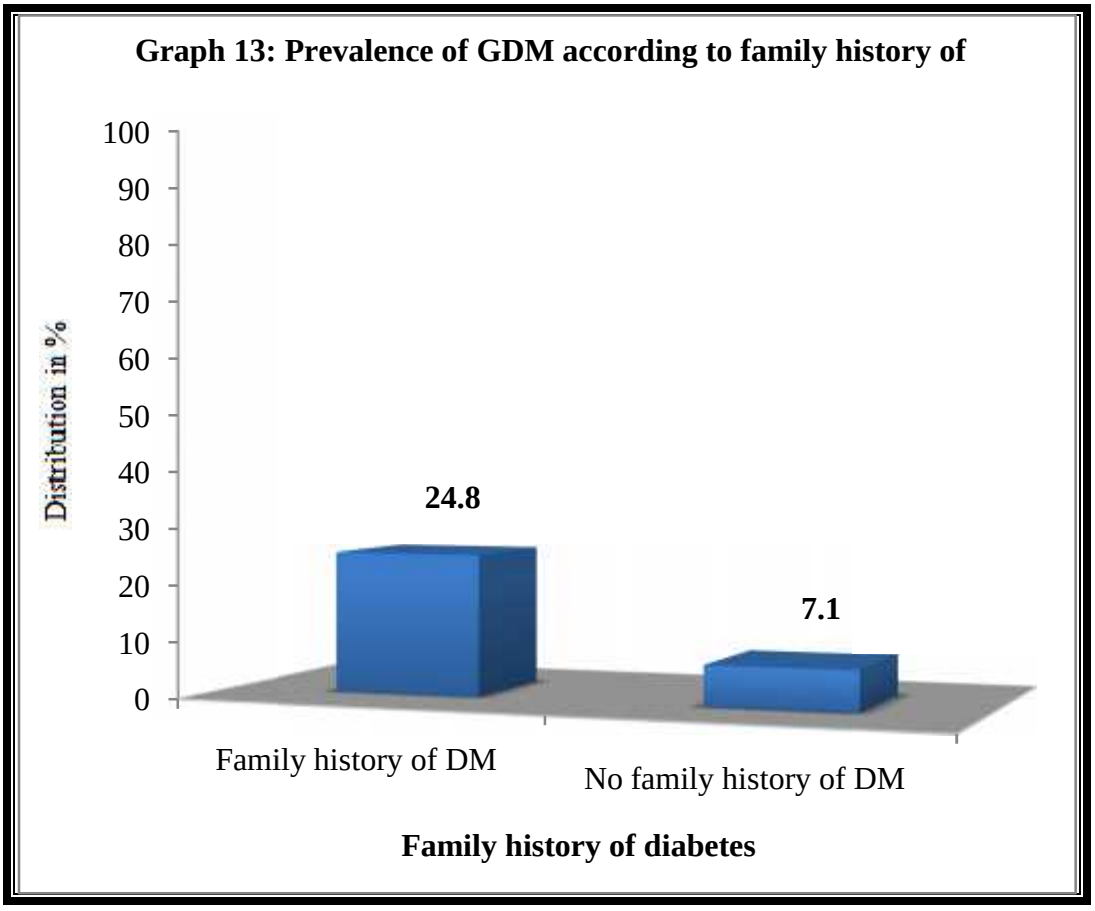

Table 30: Prevalence of GDM according to history of tobacco consume before this pregnancy.

History of tobacco use before this pregnancy	Pregnant women	GDM cases	%
Yes	43	5	11.6
No	317	39	12.3
Total	**360**	**44**	**12.2**
$\chi^2 = 0.016$	**Df = 1**	**p = 0.899**	

In the present study, prevalence of GDM was found to be 5 (11.6%) in those pregnant women who had history of tobacco consume before this pregnancy and 39 (12.3%) in those pregnant women who did not have history of tobacco consumption before this pregnancy. However, this difference was not found to be statistically significant (p = 0.899).

Table 31: Prevalence of GDM according to physical activity.

Physical activity	Pregnant women	GDM cases	%
Sufficient	96	7	7.3
Insufficient	126	9	7.1
Nil	138	28	20.3
Total	**360**	**44**	**12.2**
χ^2 = 13.578	**Df = 2**	**p = 0.001**	

In the present study 28 (20.3%) of prevalence of GDM was found in those pregnant women who did not have any physical activity. 7 (7.3%) prevalence was found in those who had sufficient physical activity and 9 (7.1%) in those who had insufficient physical activity. This difference was statistically significant (p =0.001).

Graph 14: Prevalence of GDM according to physical activity.

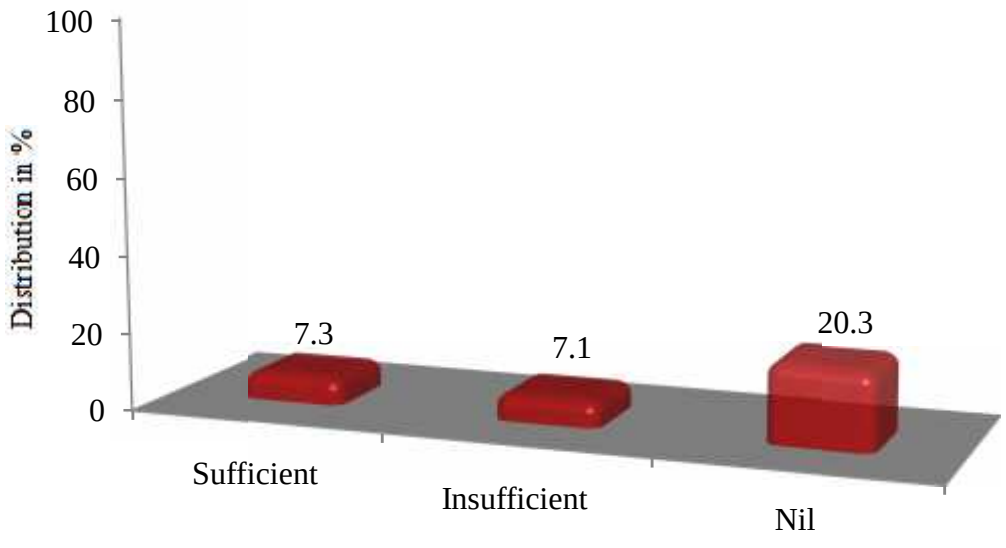

Table 32: Prevalence of GDM according to diet pattern.

Diet	Pregnant women	GDM cases	%
Vegetarian	168	20	11.9
Non vegetarian	192	24	12.5
Total	**360**	**44**	**12.2**
χ^2 = 0.030	**Df = 1**	**p = 0.863**	

In the present study, prevalence of GDM was found to be 20 (11.9%) in those pregnant women who had vegetarian diet and 24 (12.5%) who had non vegetarian diet. This difference was not statistically significant (p=0.863).

Table 33: Prevalence of GDM according to BMI

BMI	Pregnant women	GDM cases	%
<18.5 (Underweight)	21	1	4.8
18.5 to 22.9 (Normal)	186	17	9.1
23 to 24.9 (Overweight)	85	12	14.1
>25 (Obese)	68	14	20.6
Total	**360**	**44**	**12.2**
χ^2 = 7.458	**Df = 3**	**p = 0.059**	

In this study 14 (20.6%) of study participants who had GDM had BMI ≥25 and only 1 (4.8%) participant with GDM had BMI <18.5. This difference was not statistically significant (p=0.059). The trends of prevalence of GDM increased as BMI increased which was found to be statistically significant (χ^2 for trends = 7.379, p=0.007).

Graph 15: Prevalence of GDM according to body mass index (BMI)

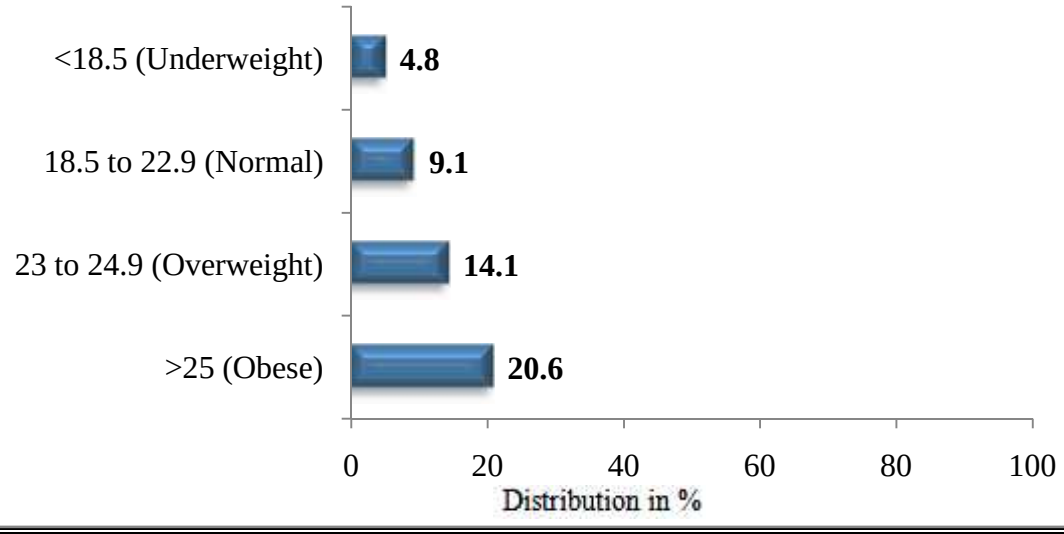

Table 34. Univariate analysis of risk factors of GDM.

Factors	Unadjusted OR	p	95% CI
Age (≥30/<30)	2.59	0.012	1.23-5.43
SES (I,II/III,IV,V)	2.53	0.006	1.29-4.93
Gravida (Multi/Primi)	2.96	0.003	1.44-6.07
Previou H/o abortion	3.57	<0.001	1.76-7.23
Previous H/o GDM	7.47	0.47	1.03-54.49
Previous H/o LSCS	2.52	0.12	1.23-5.19
Family H/o Diabetes	4.33	<0.001	2.25-8.32
Physical activity	3.28	<0.001	1.7-6.32
BMI (≥25/<25)	2.26	0.022	1.12-4.55

Univariate analysis showed that risk factors such as age [OR 2.59 (95% CI 1.23-5.43) p= 0.012], socio economic status [OR 2.53 (95% CI 1.29-4.93) p= 0.006], gravida [OR 2.96 (95% CI 1.44-6.07) p< 0.003], previous history of abortion [OR 3.57 (95% CI 1.76-7.23) p< 0.001], family history of diabetes [OR 4.33 (95% CI 2.25-8.32) p< 0.001], physical activity [OR 3.28 (95% CI 1.7-6.32) p< 0.001], BMI [OR 2.26 (95% CI 1.12-4.55) p= 0.022] are significantly associated with GDM and risk factors such as previous history of GDM [OR 7.47 (95% CI 1.03-54.49) p= 0.47] and previous history of LSCS [OR 2.52 (95% CI 1.23-5.19) p= 0.12] are not significantly associated with GDM.

Table 35. Multivariate analysis of risk factors of GDM.

Factors	Adjusted OR	p	95% CI
Age (≥30/<30)	1.41	0.455	0.57-3.46
SES (I,II/III,IV,V)	3.24	0.003	1.51-6.98
Gravida (Multi/Primi)	0.62	0.301	0.25-1.57
Previou H/o abortion (Yes/No)	1.86	0.187	0.74-4.69
Previous H/o GDM (Yes/No)	5.74	0.152	0.52-62.95
Previous H/o LSCS (Yes/No)	1.32	0.543	0.54-3.22
Family H/o Diabetes (Yes/No)	2.90	0.004	1.4-6.01
Physical activity (Nil/Other)	3.05	0.003	1.47-6.32
BMI (≥25/<25)	1.33	0.491	0.58-3.03

Multivariate analysis showed that risk factors such as socioeconomic status [OR 3.24 (95% CI 1.51-6.98) p= 0.003], family history of diabetes [OR 2.90 (95% CI 1.4-6.01) p= 0.004], physical activity [OR 3.05 (95% CI 1.47-6.32) p= 0.003] was significantly associated with GDM and risk factors such as age [OR 1.41 (95% CI 0.57-3.46) p= 0.455], gravida [OR 0.62 (95% CI 1.44-6.07) p< 0.003], previous history of abortion [OR 3.57 (95% CI 1.76-7.23) p< 0.001], BMI [OR 2.26 (95% CI 1.12-4.55) p= 0.022] previous history of GDM [OR 7.47 (95% CI 1.03-54.49) p= 0.47] and previous history of LSCS [OR 2.52 (95% CI 1.23-5.19) p= 0.12] was not significantly associated with GDM.

DISCUSSION

The present study was an attempt to establish the prevalence of GDM and to determine the risk factors associated with GDM. This one year cross sectional study was conducted at three urban health centres Ram Nagar, Ashok Nagar and Rukmini Nagar which are urban field practice area of Department of Community Medicine, Jawaharlal Nehru Medical College, KLE University, Belagavi, between the period of January 2014 to December 2014 on 360 pregnant women.

Gestational diabetes mellitus forms the most common medical complication of pregnancy. Women with GDM are at a higher risk for numerous maternal health complications and their infants are at a higher risk for death and morbidity. This study provides baseline information about the determinants of GDM, which could potentially help to incorporate early intervention measures in future.

1. Socio-demographic profile of study participants

In present study the mean age group of the study participants was 24.3±3.92 years. Of the 360 pregnant women who participated in the study, 10.3% were in the age group of ≤ 19 years, 47.2% were in the age group of 20-24 years, 28.1% were in the age group of 25-29 years and 14.4% were in ≥ 30 years age group, whereas study conducted in Kashmir[7] showed that there were no participants < 19 years and half of the participants were in the age group of 26-30 years and only 1.3% study participants belonged to age group >35 years. Another study done in Guntur, South India[43] showed 53% study participants belonged to age group 21-25 years and only 4% belonged to >30 years of age. In present study 45.3% were Hindus and 54.7% were Muslims, whereas study conducted in Assam[60] showed majority 97.7% of study

participants belonged to Hindu religion and only 2.3% to Muslim religion. (Table 1 and 2).

In present study, 5.3% were found to be illiterate, 17.5% had primary school education, 37.8% had high school education, 28.9% had PUC school education and 10.5% were graduated. A study conducted in Haryana[61] showed that, 4.9% were illiterate, 11.9% had primary schooling and 21.9% were graduated which is higher than our study. In the present study majority 95.3% of study participants were housewives and only 4.7% were working. Similarly study done at rural block of Assam[60] showed that higher proportion of participants were housewives than working. (Table 3 and 4).

In the present study 65.6% belonged to joint family and 34.4% were from nuclear family. Study done in Kerala, South India[62] showed that 26% belonged to nuclear family and 74 % belonged to joint family. In the present study only 10% belonged to class I socio economic status, 12.2% to class II, 35.6% to class III, 27.2% to class IV and 15% belonged to class V. A study conducted in North India[7] showed 45.4% of the study population belonged to socioeconomic class III 45.4% and only 1% belonged to class I. (Table 5 and 6).

In the present study 22.7% of study participants were in first trimester of gestation, 48.1% in second trimester and 29.2% of the subjects in third trimester, whereas study conducted in Kashmir[7] showed majority of participants belonged to third trimester. In the present study 46.7% were primigravida and 53.3% were multigravida. A study conducted in Guntur, South India[43] showed that 40% were primigravida and 60% multigravida. Similar to our study, a study conducted at urban

block of kashmir[7] showed that, 46% were primigravida and 54% were multigravida. (Table 7 and 8).

In present study, 15.3% were having history of abortion, 38.1% were not having history of abortion and 46.6% were not applicable to ask history of abortion because they were primigravida, whereas study conducted in Ghaziabad, Uttar Pradesh[48] showed 22% had previous history of abortion. In our study, half of the study participants did not have past history of GDM and only 1.1% had past history of GDM. Similarly study done in different regions such as Hyderabad[44], Mumbai[5] and Western Rajasthan[1] showed that less than one percent had past history of GDM. (Table 9 and 10)

In our study only 1.6% had given the past history of macrosomia whereas 51.8% had no past history of macrosomia. Study done in Guntur South India[43], showed similar results of past history of macrosomia, whereas study done in Western Rajasthan[1] showed that <1 % of study participants had past history of macrosomia. (Table 11)

In the present study, majority 70.8% of the study subjects did not have family history of diabetes and 29.2% had family history of diabetes. A study done in Rajasthan[1] showed that only 7.25% had family history of diabetes. Out of 360 study subjects, only 11.9% had history of tobacco consumption before this pregnancy and 88.1% did not have any history of tobacco use, whereas study done in Assam[60] showed 31% study participants had history of tobacco use. (Table 13 and 14)

In the present study, 18.9% were having (≥25) BMI and only 5.8% were having BMI (<18.5). Mean BMI of the study participants was 22.48±3.05 Kg/m^2. Another studies conducted in Western Rajasthan[1] and Haryana[61] showed that 27.6% and 8.2% of study participants had BMI (≥25). (Table 17)

2. Prevalence and risk factors affecting GDM

The prevalence of GDM in India varies from 3.8% to 21.0% in different parts of the country, depending on the geographical locations and diagnostic methods used. In the present study the prevalence of GDM based on DIPSI criteria was found to be 12.2%. There is wide variation in the prevalence of GDM in India. There are different studies conducted in various cities in India revealed prevalence of GDM as 13.4% in Chennai[63], 6.94% in Jammu[45], 6.6% in Western Rajasthan[1], 2.5% in Guntur, South India[43], and 7.8% in Kashmir.[7] Another study done in Tamil Nadu[52] showed that GDM was detected in 17.8%, 13.8% and 9.9% respectively in the women of urban, semi-urban and rural areas. However the wide variation in the prevalence rates of GDM may be attributed to the use of different criteria for diagnosis, variation in different geographical region. (Table 18)

In this study overall 12.2% of pregnant women had GDM. Age specific prevalence was to be found higher in age ≥30 years with prevalence of 23.1%, whereas age ≤19 years were having only 2.7% prevalence. The prevalence of GDM among the age groups showed statistically significant difference (p=0.029). The trends of prevalence of GDM increased as age increased which was also found to be statistically significant (p=0.012), whereas study conducted in Hyderabad, South India[44] showed age specific prevalence was higher in age of 20-25 years that is 73.9% and there was no GDM case in age group <20 years. Another study conducted in Guntur, South India[43] showed similar results with age specific prevalence was more in age group >30 years. (Table 19)

In our study the prevalence of GDM was found to be higher in socio economic class II 27.3% and only 7.4% prevalence was found in class V which showed

significant difference (p=0.022). The trends of prevalence of GDM decreased as socio economic status decreased which was found to be statistically significant (p=0.03). Similar study done in Kashmir[7] showed prevalence of GDM was higher in socio economic class I and II. (Table 20)

In the present study the prevalence of GDM was 15.9% both in graduated and primary school educated pregnant women. However this difference was not found to be statistically significant (p=0.323), whereas study was done in Kashmir[7] showed only 5% prevalence of GDM in primary school and graduated pregnant women. (Table 21)

In the present study the prevalence of GDM was 17.6% in working pregnant women and only 12% in housewives. However this difference was not found to be statistically significant (p=0.749). In the present study, the prevalence of GDM was higher in third trimester that is 17.1%. This difference was not statistically significant (p = 0.161). Similarly study done in Kashmir[7] showed prevalence was higher in third trimester. (Table 22 and 23)

In our study it was seen that as the gravidity increased prevalence of GDM increased, 17.2% of multigravida and 6.5% of primigravida had GDM. This shows that the severity of gestational diabetes mellitus increases with gravidity which is found to be statistically significant (p=0.002). A study done in Guntur, South India[43] showed similar results where in the prevalence of GDM was higher in multigravida as compared to primigravida. Similarly study conducted in Kashmir, North India[7] showed that as the gravidity increased the prevalence of GDM increased. (Table 24)

Among study participants who were having the previous history of abortion the prevalence of GDM was 27.3% much higher than those who did not have previous history of abortion. This difference was statistically significant when compared with

the risk categories (p<0.0010). A study done in Kashmir[7] also showed 33% prevalence of GDM in those study participants who had previous history of abortion. (Table 25)

In our study 50% of them reported to have GDM in those who had previous history of GDM. This difference was statistically significant (p<0.001), whereas study conducted in Guntur, South India[43] showed only 20% have GDM those who had past history of GDM. In the present study 33.3% prevalence of GDM was found in those pregnant women who had previous history of macrosomia, and 16.7% was in those who did not had any previous history of macrosomia. This difference was statistically significant (p=0.003), whereas study conducted in Guntur, South India[43] showed there is no association between previous history of GDM and macrosomia with prevalence of GDM (Table 26 and 27)

In our study, 16.1% had past history of LSCS and 37.3% were not having past history of LSCS. Among 360 pregnant women, prevalence of GDM was 22.4% in those who had previous history of LSCS and only 14.9% in those who had no previous history of LSCS. This difference was statistically significant (p = 0.003). (Table 12 and 28)

In the present study the prevalence of GDM was 24.8% in those pregnant women who had family history of diabetes which was statistically significant (p<0.001). Studies conducted in Kashmir[7] and Hyderabad[44] showed significant association between family history of diabetes with GDM. (Table 29)

In the present study the prevalence of GDM was found to be 12.3% in those pregnant women who did not have history of tobacco use before this pregnancy. There was no statistically significant difference (p=0.899). Similar results found,

Study conducted in Assam[60] showed that only 14.3% had GDM in those who had history of tobacco use. (Table 30)

In the present study, 26.7% of the pregnant women had sufficient physical activity, 35% had insufficient and 38.3% had not done any physical activity. Exercise has been advocated as an alternative intervention not only in management of gestational diabetes but also in prevention of diabetes. The studies have revealed physical activity plays a vital role in maternal carbohydrate metabolism.[7] In our study prevalence of GDM was more 20.3% among sedentary women those who did not have any physical activity compared to 7.3% and 7.1% women with sufficient or insufficient physical activity respectively. Women were particularly benefitted much better if they were physically active prior to and during pregnancy. This difference was found to be statistically significant (p =0.001). (Table 15 and 31)

In the present study, 46.7% of the pregnant women were found to be consuming vegetarian diet and 53.3% were having non vegetarian diet. In our study, prevalence of GDM was found to be similar in both vegetarian and non vegetarian study participants 11.9% and 12.5% respectively. This difference was not statistically significant (p=0.863). (Table 16 and 32)

In the present study majority 20.6% of study participants who had GDM had BMI ≥ 25 and only one (4.8%) participant with GDM had BMI <18.5. This difference was not statistically significant (p=0.059). The trends of prevalence of GDM increased as BMI increased which was found to be statistically significant (p=0.007). Similar findings with increased prevalence of GDM among pregnant women having BMI ≥ 25 was observed in a study done in Hyderabad, South India.[44] (Table 33)

CONCLUSION

The prevalence of GDM is 12.2% in the present study and there is a greater prevalence of GDM in women with increasing age, higher parity, increasing BMI and a family history of diabetes mellitus. There is a need for universal screening to pick up gestational diabetes mellitus to prevent both maternal and fetal morbidity. Larger studies are needed to analyse the risk factors for GDM in Indian women and plan for preventive strategies and to improve maternal and neonatal outcomes. Based on these results it concluded that, the diagnosis of GDM based on DIPSI method is a convenient, quick and cost effective.

LIMITATIONS

The limitations of the study are:

- In the present cross sectional study, some of the study participants were tested for GDM in their first trimester, we would have missed those who developed GDM in the later part of their pregnancy.
- A longitudinal study which includes follow up of study participants would yield better results as more GDM cases could be identified during their subsequent visits.

RECOMMENDATIONS

On the basis of this study, following recommendations are being suggested for the prevention of gestational diabetes mellitus and improvement of health of pregnant women by assessment of the risk factors:

- Universal screening for GDM should be followed, as women of Asian origin and especially Indians are at a higher risk of developing GDM.
- DIPSI recommended this one step procedure of challenging women with 75gm glucose and diagnosing GDM is simple, economical and feasible.
- DIPSI method should be implementing routinely for antenatal check up at primary health care level.
- Life style modifications like increase in physical activity decrease in consumption of sweetened beverages and high energy dense foods should be started early in life and continued throughout the life.
- Increasing prevalence of gestational diabetes mellitus and its co-morbidities among females need immediate attention in terms of prevention and health education.

SUMMARY

The present study was a cross sectional study undertaken to assess the prevalence of gestational diabetes mellitus in pregnant women and to determine the risk risk factors associated with gestational diabetes mellitus.

This study was carried out in three Urban Health Centres Ram Nagar, Ashok Nagar and Rukmini Nagar which are urban field practice area of Department of Community Medicine, J. N. Medical College, Belagavi. A total of 360 pregnant women were selected for the study and the duration of study was one year from 1st January 2014 to 31st December 2014. A pre-designed and pre-tested questionnaire was used to collect the data from the participants. Diagnosis and the prevalence of GDM were assessed by applying DIPSI criteria.

In the current study majority, 47.2% participants were belonged to 20-24 years of age group and mean age was 24.3±3.92 years, 54.7% were Muslim by religion. A large number of study participants had studied up to high school 37.8%. As many 95.3% pregnant women were housewives and 65.6% were living in a joint family. Most of participants belonged to class III socio-economic status as per modified B G Prasad classification. In this study, 48.1% pregnant women were in first trimester. 53.3% were multigravida and 46.7% were primigravida. Previous history of abortion was present in 15.2% participants of study participants.

Only 1.1% participants had previous history of GDM and 1.6% participants had previous history of macrosomia. Majority 70.8% did not have family history of diabetes and 38.3% pregnant women did not have any physical activity. Mean BMI of

the study participants was 22.48±3.05 kg/m^2 and 51.7% had normal BMI. In this study the prevalence of GDM according to DIPSI criteria was 12.2%.

There was statistically significant difference was observed in risk factors such as age, gravidity, previous history of abortion, previous history of GDM, previous history of macrosomia, previous history of LSCS, family history of diabetes and physical activity with GDM.

The trends association was observed statistically significant in age associated with GDM (p=0.012) as the age was increased the prevalence of GDM was increased. In BMI trends association was observed statistically significant as the BMI increased the prevalence of GDM was increased (p=0.007) and in socio-economic status the trends of prevalence of GDM decreased as socio-economic status decreased which was found to be statistically significant also (p=0.03) in this study.

The increased trend of GDM in India has become a public health problem. Timely action should be taken to screen all pregnant women for glucose tolerance, and achieve euglycemia in them and ensure a healthy diet, regular physical activity and follow up at antenatal clinics, would definitely reduce the further rise of GDM and poor outcome of pregnancy.

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ANNEXURE IV – KEY TO MASTER CHART

A. Serial No.

B. Age in years

C. Area of residence

1. Ram Nagar
2. Ashok Nagar
3. Rukmini Nagar

D. Religion

1. Hindu
2. Muslim
3. Christian

E. Education

1. Illiterate
2. Primary school
3. High school
4. PUC
5. College / Graduation

F. Occupation

1. Working
2. Housewife

G. Type of family

1. Joint
2. Nuclear family

H. Socio economic status

1. Class I
2. Class II
3. Class III
4. Class IV
5. Class V

I. Period of gestation in weeks

J. Birth control measure

1. Yes
2. No

K. Type of birth control measure used

1. Hormonal
2. Non hormonal
3. Not used

L. Gravida

1. Primigravida
2. Multigravida

M. Previous history of abortion

1. Yes
2. No
3. Not applicable (Primigravida)

N. Previous history of GDM

1. Yes
2. No
3. Not applicable (Primigravida)

O. Previous history of macrosomia

1. Yes
2. No
3. Not applicable (Primigravida)

P. Previous history of LSCS

1. Yes
2. No
3. Not applicable (Primigravida)

Q. Family history of diabetes

1. Yes
2. No

R. Family history of GDM

1. Yes
2. No

S. History of tobacco use before this pregnancy

1. Yes
2. No

T. History of tobacco use during present pregnancy

1. Yes
2. No

U. Form of tobacco consume

1. Smoking
2. Chewing
3. Both
4. Not used

V. Physical activity

1. Sufficient
2. Insufficient
3. Nil

W. Diet

1. Vegetarian
2. Non- vegetarian

X. Height in Cms

Y. Weight in Kgs

Z. BMI in Kg/m^2

AA. Average Systolic Blood Pressure in mm/Hg

AB. Average Diastolic Blood Pressure in mm/Hg

AC. DIPSI value in mg/DL

AD. GDM (Based on DIPSI value)

1. Positive
2. Negative

ANNEXURE – I – ETHICAL CLEARANCE LETTER

K.L.E.SOCIETY'S
JAWAHARLAL NEHRU MEDICAL COLLEGE,
NEHRU NAGAR, BELGAUM-590010 (KARNATAKA-INDIA)
(Affiliated to KLE University, Belgaum)

Website: http/www.jnmc.edu
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Fax No. +91 (0)831 – 2470759

Ref: MDC/DOME/90 **Date: 07/12/2013**

To,

(REG.NO.BD0113002)

Sub: Institutional Ethical Clearance for the study.

With reference to the above, we wish to inform you that your proposed research project titled "**PREVALENCE OF GESTATIONAL DIABETES MELLITUS AMONG PREGNANT WOMEN ATTENDING ANTENATAL CLINIC AT THREE URBAN HEALTH CENTRES OF BELGAUM – A CROSS SECTIONAL STUDY**," is ethical and justifiable. The proposed research project has been cleared by the JNMC Institutional Ethics Committee on Human Subjects Research.

(Dr.Hema Dhumale)
Member Secretary
JNMC Institutional Ethics Committee
on Human Subjects Research,
J.N.Medical College, Belgaum.

(Dr.Ganga Pilli)
Chairman,
JNMC Institutional Ethics Committee
on Human Subjects Research,
J.N.Medical College, Belgaum.

ANNEXURE II

INFORMED CONSENT

PREVALENCE OF GESTATIONAL DIABETES MELLITUS AMONG PREGNANT WOMEN ATTENDING ANTENATAL CLINIC AT THREE URBAN HEALTH CENTRES OF BELAGAVI - A CROSS SECTIONAL STUDY

INVESTIGATORS: _____

Introduction

Gestational diabetes mellitus is a major public health problem. Gestational diabetes mellitus is associated with increased incidence of maternal hypertension, pre-eclampsia and risk of developing Diabetes Mellitus in later life. Major morbidities associated with infants of diabetic mothers include respiratory distress, growth restriction, and congenital malformation. Therefore this study is being conducted to find out the prevalence of gestational diabetes mellitus in pregnant women attending antenatal clinics in three urban health centres Ram Nagar, Ashok Nagar, Rukmini Nagar, Belagavi and you are invited to participate in this study. Participation in this study is completely voluntary.

Explanation of procedures

In this study you will have to answer a few questions about your general health information, socio-demographic details, nutritional health status and interventional procedure. The entire procedure may take 2-hours.

Possible benefits

The investigator does not promise or guarantee that you will receive direct benefit being in the study. It will benefit the whole community because by this study we will know the prevalence of gestation diabetes mellitus, and accordingly the preventive and control measures can be taught.

Possible risks

There are no risks involved for participation in the study

Confidentiality

Your identity will not be revealed. All information collected will be collected and coded so that no one will know your identity.

Withdrawal

Participation in this study is voluntary. If you do not wish to participate in this study, you will not lose benefits to which you are entitled.

Costs of participation

The cost of the study will be borne by the researcher. There will be no additional cost to you for participating in this study.

Payment of participation

There will be no incentives to you for participating in this study.

Authorization to publish results

The researchers may use the information gathered from this study for presentation in scientific journals. However your identity will not be disclosed in such presentation or publication.

Legal rights

By signing this consent form, you are not waiving any of your legal rights.

Questions

If you have any questions about this study, you may contact _____, If you have any questions about your rights as a study participant, you may contact Dr Ganga S. Pilli, Chairman, JNMC Institutional Ethics Committee on human subjects research at 0831- 2741701.

Consent statement

I volunteer and consent to participate in this study. I have read the consent or explained to me in my local languages. The study has been fully explained to me and I had been given the opportunity to ask questions and they have been answered to my satisfaction and that I have received a copy of this signed consent form.

Name of the participant: _____ Signature/ left thumb impression

Name of the eyewitness: _____ Signature/ left thumb impression

Name of the interviewer: _____ Signature

Signature of the guide:

Date: | | | |

ANNEXURE III – PROFORMA

K.L.E. UNIVERSITY's

J.N.MEDICAL COLLEGE, BELAGAVI

DEPARTMENT OF COMMUNITY MEDICINE

RESEARCH QUESTIONNAIRE

Investigator: _____ Guide: _____

"PREVALENCE OF GESTATIONAL DIABETES MELLITUS AMONG PREGNANT WOMEN ATTENDING ANTENATAL CLINIC AT THREE URBAN HEALTH CENTRES OF BELAGAVI - A CROSS SECTIONAL STUDY"

PART - I SOCIO DEMOGRAPHIC DATA

Name : _____ S.No:

Age : _____years

Area of residence : _____

1. Religion: 1. Hindu
   2. Muslim
   3. Christian
   4. Others
2. Education: 1. Illiterate
   2. Primary school
   3. High school
   4. Pre-university College
   5. Graduation
3. Occupation: 1. Working
   2. Housewife

4. Type of Family: 1. Joint

2. Nuclear

5. a. Monthly income of the family:

b. Total number of family members:

c. Monthly per capita income:

6. Socio economic status: (Modified B. G. Prasad classification):

1. Class I

2. Class II

3. Class III

4. Class IV

5. Class V

PART II- FEMALE SPECIFIC

7. Have you ever used birth control measures?

1. Yes

2. No

8. If yes what kind of?

1. Hormonal

2. Non Hormonal

3. Not used

9. Obstetric Information:

a) Last menstrual period (LMP)

b) Expected date of delivery (EDD)

c) Gestation age

d) Pregnancy Score: G_P_L_A

10. Gravida

    1. Primigravida

    2. Multigravida

11. Past History of abortion

    1. Yes

    2. No

    3. Not applicable (Primigravida)

12. Any previous history of gestational diabetes mellitus

    1. Yes

    2. No

    3. Not applicable (Primigravida)

13. Any past history of diabetes mellitus

    1. Yes

    2. No

15. Any past history of tuberculosis/cardiac disease/liver disease/renal disease

    1. Yes

    2. No

16. Any previous history of macrosomia in previous pregnancy (weight≥4kg)

    1. Yes

    2. No

    3. Not applicable (Primigravida)

17. Any previous history of LSCS

    1. Yes

    2. No

    3. Not applicable (Primigravida)

PART III: 1. FAMILY HISTORY

17. Any family history of diabetes

    1. Yes

    2. No

18. Any family history of gestational diabetes mellitus

    1. Yes

    2. No

PART IV- PERSONAL HEALTH HABITS

19. Any history of tobacco use before this pregnancy

    1. Yes

    2. No

20. Any history of tobacco use during present pregnancy

    1. Yes

    2. No

21. Form of tobacco consumed

    1. Smoking

    2. Chewing

    3. Both

    4. Not consumed

PART V- PHYSICAL ACTIVITY AND NUTRIONAL HISTORY

22. Do you participate in physical activity

    1. Sufficient

    2. Insufficient

    3. Nil

23. Which type of diet you use

1. Vegetarian

2. Non- vegetarian

PART VI – CLINICAL EXAMINATION

I) General Physical Examination

1. Built and nourishment: Good / Moderate / Poor
2. Height: _____ cms Weight: _____ Kgs.
3. BMI:_____
4. Pallor: Present/Absent
5. Icterus: Present/Absent
6. Pedal oedema: Present/Absent
7. Lymphadenopathy: Present/Absent
8. Cyanosis: Present/Absent
9. Clubbing: Present/Absent

Vital signs:

Respiration rate: ___/min. Blood pressure: __Systolic/Diastolic mm/Hg

Pulse rate: _____/min. Temperature: ___Febrile / Afebrile

II) Systemic Examination:

1. Per abdomen:
2. Cardio Vascular system:
3. Respiratory System:
4. Nervous System:

PART VII – INVESTIGATION PROFILE

Date	Test	Result	
	(DIPSI)	Positive (≥140mg/dl)	Negative