Prevalence of gestational diabetes mellitus and its associated risk indicators: A hospital based study in Nepal

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Abstract

Background: Gestational diabetes mellitus is increasing enormously worldwide in the recent decades especially in developing countries. The prevalence of Gestational Diabetes mellitus (GDM) differs depending on the regions and the country. Nearly half of women with a history of GDM develop type 2 diabetes within five to ten years after delivery. Out of 25 pregnancies 1 develop GDM which is associated with complications in the period immediately before and after birth. It is one of the causes of maternal and fetal mortality and morbidity. Due to lack of data on prevalence of GDM, particularly from Nepal we conducted the study.

Objectives: The goal of the study is to determine the prevalence and to identify associated risk indicators of GDM.

Methods:

Design & source of data: A cross sectional epidemiological study was conducted in urban antenatal clinic in Nepal for 6 months (1st July-31st December 2013). 510 eligible pregnant women who were willing to take part in the study between 24 and 28 weeks of pregnancy were the recruited participants. All of them underwent 50gm GCT followed by 75gm OGTT, if the value of GCT≥ 140mg/dl, to confirm GDM. Descriptive, univariate and multivariate binary logistic regression was done to see the effect modification of GDM on different variables.

Results: GDM was diagnosed in 22 (4.3%) women. In this study, the progressing maternal age was independent risk indicators for GDM in univariate and multivariate analysis. In overweight and obesity BMI was found significant in univariate analysis. The non-vegetarians had 70% risk of being overweight and obese and 3 folds probability to develop GDM than vegetarians. No significant association with GDM was found for physical activity, parity, education, occupation, socio-economic status.

Conclusion: Appropriate intervention is needed for control and risk indicator modification for GDM. Absence of association of GDM with important risk indicators is due to lack of statistical power.

Keywords: gestational diabetes mellitus, prevalence, risk indicators, Nepal, developing country.

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Abbreviation

ADA- American Diabetic Association

BMI- Body Mass Index

CI- confidence interval

DM- Diabetes Mellitus

FBG – Fasting Blood Glucose

GCT- Glucose Challenge Test

GDM- Gestational Diabetes Mellitus

GDP- Gross Domestic Product

IADPSG- International Association of Pregnancy Study Group

IDDM- Insulin Dependent Diabetes Mellitus

IMR- Infant Mortality Rate

MDG- Millennium Development Goal

MMR- Maternal Mortality Rate

NIDDM- Non- Insulin Dependent Diabetes Mellitus

OGTT- Oral Glucose Tolerance Test

OR- Odds Ratio

PPP- Purchasing Power Parity

T2DM- Type 2 Diabetes Mellitus

WHO- World Health Organisation

WFB- World Fact book

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Chapter 1

Introduction

1.1 Country profile

Nepal is a beautiful country with natural beauty; however, it is among the poorest and least developed countries in the world. It has been seen that about one-quarter of its population living below the poverty line. It is estimated that 25.2% of population are below the poverty line.

1.1.1 Geography

Map of Nepal

Map of Nepal with its surrounding boundary (World Fact Book[WFB], 2014)

Location:

Nepal is a landlocked country, sandwiched between China on the north and India on the east, west and south. It is situated between the latitudes of 28 00 N, 84 00 E. It has the eight of world's 10 highest peaks, including Mount Everest and Kanchenjunga the world's tallest and third tallest mountains respectively. The temperature varies from cool summers and severe winters in north to subtropical summers and mild winters in south.

Local currency: A Nepalese rupee (NPR) is the local currency and the exchange rate per US dollar is approximately 100 NPR.

1.1.2 Economy

Nepal greatly depends on remittances, which amount to as much as 22-25% of GDP. Per capita (PPP) is $1,500 for nepalese people. Agriculture is the main source of the income providing a livelihood for more than 70% of the population and accounting for a little over one-third of GDP. In 2011 heath expenditure is 5.4% GDP and people have to spend money by themselves for basic health care requirements.

1.1.3 People and culture

Total population of Nepal is 26,494504 (CBS, 2012). The population is growing at the rate of 1.82% . The birth rate estimation for 2014 is 21.07 births/1,000 populations.

Majority of Nepalese are Hindus who are about 81.3%, Buddhist is 9%, and rest are of other religion. Nepali is an official language and 123 other languages are also spoken for communication.

1.1.4 Education

Total literacy rate is 57.4% and female literacy rate is 46.7% and male is 71.1%. In 2010 education expenditure was 4.7% of GDP.

1.1.5 Life style and physical activity:

Nepal is a male dominating society, women take care of the household activity like cooking, cleaning, washing; Most of the Nepalese women do not perform extra physical activity apart from their daily domiciliary activity.

1.1.6 Food habit:

Rice is a staple food of Nepal and is taken rice at least twice a day with lentils and vegetables. Meat products are taken twice or thrice a week. Fruits and salads are taken frequently but not on daily basis.

1.1.7 Trend of urbanisation:

People are moving towards the urban area for job opportunity, good living standard and health care facility. Nearly 17% of total population in the year 2011 live in urban area. In 2009 there were 990,000 people were residing in Kathmandu (capital) alone.

1.1.8 Overall health status in Nepal:

Maternal mortality rate is 170 deaths/100,000 live births (2010). Infant mortality rate is 40.43 deaths/1,000 live births. Death rate is 6.62 deaths/1,000 populations (2014 est.) HIV deaths are 4100 in 2012 est. Nearly 50, 0000 .The major infectious diseases are food or waterborne diseases: bacterial diarrhoea, hepatitis A and E, and typhoid fever. Other vector borne disease: Japanese encephalitis, malaria, and dengue fever (2013). The adult prevalence rate of obesity 1.4% (2008). Hospital bed density is 4.7 beds/1000 populations in 2009 census. Around 29.1% of Children under the age of 5 years were underweight (2011). (World fact book,2014)

1.2 Diabetes mellitus –Background

Diabetes mellitus is chronic hyperglycaemia with disorders of carbohydrate, fat and protein metabolism and resulting from defects in insulin secretion, insulin action, or both. Diabetes mellitus leads to progressive development complications of retinopathy with potential blindness, nephropathy that may lead to renal failure, and/or neuropathy with risk of foot ulcers. People with diabetes are at increased risk of cardiovascular, peripheral vascular and cerebrovascular disease (WHO, 1999).

Types of diabetes mellitus

1. Type 1 formerly known as IDDM or juvenile or childhood onset fail to produce insulin which is essential for lowering the blood sugar. It is mainly seen in children and adolescents. Daily administration of insulin is required for survival. The cause is unknown and unpreventable with the current knowledge.
2. Type 2 formerly known as NIDDM or adult onset where the body is unable to respond properly to the produce insulin by pancreas. It is more common as 90% of people are suffering from Type 2 diabetes around the world .This type of diabetes is mainly due to obesity and physical inactivity. Type 2 DM was seen in adult only, but now it occurs in children and adolescent as well. People with type 2 may require oral hypoglycaemic drugs or need insulin injections (WHO, 1999).
3. Gestational Diabetes Mellitus
4. Other specific type of diabetes e.g. Genetic defect of β cell function; Genetic defect in insulin processing or insulin action; Disease of the exocrine pancreas; Endocrinopathies; Drug or chemical induced diabetes; Infection; Uncommon forms of immune mediated diabetes; Genetic syndrome.

1.2.1 The global burden of diabetes and GDM

The global prevalence of diabetes is 16.9% and 80%of them live in low and middle-income countries. It is estimated that 382 million people have diabetes and the number will rise to 592 million by 2035 in less than 25 years. It is miserable that around 175 million people with diabetes are not diagnosed. Every six seconds a person dies from diabetes. In 2013, 5.1 million died due to diabetes. IDF estimates that number of live births with hyperglycaemia in pregnancy is 21.4 million which accounts for 16.8% of total live births in 2013**.** South-East Asia Region has the highest prevalence of 25.0% compared with 10.4% in the North America and Caribbean Region. It develops in 1 in 25 pregnancies worldwide and is associated with complications in the period immediately before and after birth. Nearly half of women with a history of GDM develop type 2 diabetes within five to ten years after delivery (IDF, 2013).

1.2.2 Diabetes in Nepal

The reports published from Nepal on prevalence of diabetes are less in numbers. The true magnitude of diabetes has remained unknown as there is no nationwide prevalence surveys of diabetes have undertaken in Nepal. In a central hospital in Nepal, out of total medical admissions, the proportion of diabetic patients increased over 4 years from 2.6% in April 1990-March 1991 to 5.6% in April 1993-March 1994 (Singh, Bhattarai &Maskey, 1995). The extent of the problem may be even greater since fasting glucose alone detects only half of diabetes defined by 2-h glucose in Asian populations. The Nepal Diabetes Association reported that diabetes affects approximately 15% of people ≥ 20 years and 19% of people ≥ 40 years of age in urban areas (Bhattarai & Singh, 2007). According to WHO, diabetes affects more than 436,000 people in Nepal, and this number will rise to 1,328,000 by 2030 (Wild, Roglic et al., 2010). The percentage of diabetic patients has increased from 19.04% in 2002 to 25.9% in 2009 in Nepal (Dulal & Karki , 2009). Nepal has not been different from other countries and the diabetes are growing gradually, it is mainly because people have become health conscious, they prefer to do lab investigation and diabetes is detected early. Today laboratory technology is advanced for identifying the diseases so numbers of cases are rising for many illnesses. Similar has happened in the case of diabetes as well. In Nepal such technology has been introduced so diseases become noticeable.

1.3 Gestational Diabetes Mellitus

Gestational Diabetes is defined as onset of glucose intolerance at varying degree or first diagnosed during pregnancy (Metzer & Coustan, 1998). GDM has a potential risk to the mother as well as the fetus. Out of the 8 goals stated by the United Nation Millennium Development Goal (MDG), 4^{th} goal targets the reduction in child mortality and 5^{th} goal states the upgrading the maternal health. GDM, accounts for the health of mother and child. GDM is responsible for progression of the type 2 diabetes in about 50% of GDM mothers (IDF, 2013).

Especially in south Asian countries, there is a growing prevalence of GDM. In India GDM has been found to be more common in women living in urban areas than in women living in rural areas (Zargar, et al., 2004). The prevalence of GDM is high in India and fluctuates according to geographical areas and diagnostic methods used (Zargar, Sheikh & et.al, 2004, Divakar, Tyagi et.al 2008). The prevalence of GDM in India ranges from 3.8% to 21% depending upon the diagnostic method used (Jali et al., 2011).According to a random national survey conducted in 2004 the GDM prevalence was 16.55% (seshiah, Balaji et. al., 2004)). In 2008, a hospital based survey showed a combined prevalence of GDM and IGT to be 21.6% (Swami, Mehetre et.al, 2008).

A study conducted during 2005-2007 at Patan hospital in Nepal found the incidence of GDM 0.4% (Sharma & Shrestha, 2010). Another study at Dhulikhel hospital detects 0.75% of GDM by using Carpenter Coustan criteria (Shrestha & Chawla, 2011).. Effective preventive strategy/s reduces GDM to some extent helping to strengthen the MDG. Due to lack of proper data, particularly in Nepal, the prevalence of GDM and risk indicators are not known. Hence our study mainly focuses on the prevalence and the risk factors of GDM in Nepal.

1.3.1 Prevalence of GDM

Recent data show that gestational diabetes mellitus (GDM) prevalence has increased by 10–100% in several race/ethnicity groups during the past 20 years. In the U.S., Native Americans, Asians, Hispanics, and African- American women are at higher risk for GDM than non-Hispanic white women (Doery,Edis, & et al., 1989; Green, Pawson, et al., 1990; Solomon,Willet et al, 1997; Thorpe,Berger et al,2005). The proportion of pregnancies complicated by GDM in Asian countries has been reported to be lower than the proportion observed in Asian women living in other continents (Yang, Hsu, et al., 2002). A study performed in Australia found that GDM prevalence was higher in women whose country of birth was China or India than in women whose country of birth was in

Europe or Northern Africa (Beisher, et al., 1991). GDM prevalence was also higher in Aboriginal women than in non- Aboriginal women (Ishak, & Petocz, 2003). In Europe, GDM has been found to be more common among Asian women than among European women (Dornhost, Paterson, et al., 1992).

A hospital based cross sectional study is conducted to observe the prevalence of GDM in Nepal. There are very few studies regarding GDM in Nepal so there is a need to do research on GDM to know more about it for the betterment of the health of mother and child. It is a public health issue and it should be monitored carefully in order to save the life of mother and child. In poor resource setting country like Nepal disease remains hidden and noticed only after the complication arises.

1.3.2 Glucose intolerance in normal and GDM pregnancy

Pregnancy is a normal phenomenon, there are many hormones act during pregnancy. Insulin resistance begins in mid of second trimester and continues to third trimester as well. Insulin resistance is due to placental hormones; though β cells of pancreas increases the production of insulin to cope with the insulin resistance during pregnancy, the changes in the circulating glucose level during pregnancy is low in divergence to extreme changes in insulin sensitivity (Buchanan & Xiang, 2005). Insulin resistance increased in GDM pregnancy than normal pregnancy. The metabolism of Carbohydrate, protein and fat are affected by insulin resistance. Once the baby was born, GDM may disappear but to some it may persist as diabetes, impaired fasting glucose even after delivery. There is chance of recurrence in the following pregnancy or any time after delivery (Ben, Yogev &Hod 2004).

1.3.3 Pathogenic factor for gestational diabetes

Pregnancy, though a normal condition insulin resistance occurs with a compensatory increase in β-cell response resulting in hyperinsulinemia. Insulin resistance usually happens in the second trimester and progresses throughout the third trimester of the pregnancy. 80% insulin sensitivity is reduced by placental hormones, such as progesterone, cortisol, placental lactogen, prolactin, and growth hormone. The insulin resistance causes adequate supply of glucose by changing the maternal energy metabolism from carbohydrates to lipids (Cianni, Miccoli, et al., 2003).

"The other suggests that Genetic GDM where the autoimmune and insulin resistant forms of diabetes outside of pregnancy, diseases for which GDM is often a precursor, are heritable, and some contributory genetic variants have been defined. Evidence was presented that some of the variants may contribute to GDM or its physiological phenotypes (insulin resistance, cell dysfunction), but the

studies to date are relatively small, as are the potential genetic contributions. The contribution of genetics to other forms of GDM is not well established. Placental GDM : Evidence presented that was obtained from human term placentas studied in vitro indicates that placental glucose transport and metabolism are normal in GDM pregnancies, despite increased glucose fluxes from mother to fetus that result from increased glucose concentrations on the maternal side" (Metzer, Buchanan & coustan , 2007).

1.3.4 Screening of GDM

Screening criteria in hospital varies and have their own protocol with different diagnostic norms used in Nepal. However in two recent comprehensive reviews, evaluated the screening and diagnosis protocol for GDM, all pregnant women should be assessed for clinical characteristics to determine the risk of GDM by a 50-g oral glucose-challenge test (GCT), usually between 24 and 28 weeks of gestation, followed by an oral glucose tolerance test (OGTT) if the serum glucose concentration at screening is high unless they have a low-risk clinical profile (Hanna and Peters, 2002, Kjos and Buchanan, 1999). We will highly suggest doing GCT screening irrespective of risk indicators prone to GDM or not, as it is very crucial.

Women using a glucose cut-off value of ≥ 140 mg/ dl (7.8 mmol/ l) the GCT is positive in 14–18%, and using a cut-off level of ≥ 130 mg/dl (7.2 mmol/ l) the positivity is in 20–25%, with sensitivity rates of approximately 80% and 90% for the diagnosis of GDM respectively. The lower cut-off value also lowers the specificity by 25% (Hanna and Peters, 2002). The hospital where we conducted the study performed the 50 gm GCT to pregnant women visiting between 24 and 28 weeks. The cut off level taken is ≥140mg/dl followed by OGTT to confirm GDM

1.3.5 Diagnostic criteria proposed used in different studies on GDM

The diagnostic criteria for GDM performed by country, committee, and people vary. The ADA expert committee (1997) recommended a screening test performed with a 50 gm glucose test between 24 and 28 weeks of pregnancy. Those values were based on the cut off value proposed by O'Sullivan and Mahan's value. NDDG (National Diabetes Data Group) converted these to plasma values in 1979. There was a disagreement on O'Sullivan and Mahan's value interpretation. The substrate measured were changed to venous plasma from venous blood, the laboratory technique was transferred to enzymatic method from Somogyi-Nelson method. In 1982 Carpenter and Coustan modified on the NDDG based O'Sullivan and Mahan's value. The value proposed by Carpenter and Coustan was recommended by the Fourth International Workshop-Conference on Gestational

Diabetes Mellitus (Metzer& Coustan, 1998). Some follow WHO criteria, ADA criteria, IADPSG criteria, Carpenter Coustan criteria and many more.

The diagnosis of gestational diabetes mellitus at any time during pregnancy should be based on any one of the following values:

- Fasting plasma glucose = 5.1-6.9 mmol/l (92 -125 mg/dl)
- 1-h post 75g oral glucose load >=10.0 mmol/l (180 mg/dl)*
- 2-h post 75g oral glucose load 8.5 – 11.0 mmol/l (153-199 mg/dl)

*****There are no established criteria for the diagnosis of diabetes based on the 1-hour post-load value.

The quality of evidence is very low and strength of recommendation is weak.

The recommended glucose cut-off value for GDM corresponds to those proposed by IADPSG and is lower than those recommended by earlier guidelines. Unlike earlier guidelines, they are based on the association of plasma glucose and adverse maternal and neonatal outcomes during pregnancy, at birth and immediately following it. The difference from IADPSG guidelines is that these new WHO guidelines set a range of plasma glucose levels to distinguish diabetes in pregnancy and GDM (WHO, 2013).

1.3.6 Clinical importance of GDM

Clinically GDM is a high risk factor for mother and child. If left undetected or untreated d it may lead to serious complication to both the mother and the child. The immediate complication to the mother is pre- eclammpsia, obstructed labour, caesarean delivery and in delayed complication due to rise in blood sugar lead to infection, delayed wound healing. The child may be hypoglycaemic, macrosomic, shoulder dystocia or may lead to intrauterine death. Hence it becomes compulsory for all the pregnant women to undergo random blood glucose at the first antenatal visit to detect diabetes in pregnancy.

1.3.7 Risk indicators for GDM

Repeatedly stated risk indicators for GDM are as follows, increase maternal age, parity, increasing weight, positive family history of diabetes, previous history of GDM, less physical activity, previous history of macrosomic delivery of the baby. A population based study conducted in Sweden found increasing maternal age, and high BMI were risk factor for increase OGTT values (Ben - Haroush, Yogev & Hod, 2004).

A study conducted in U.S. Showed a risk of developing GDM is 2, 4, 8 times higher among overweight, obese and severely obese women compared with normal weight pregnant women (Chu, Callaghan, et.al, 2007).

Universal screening on GDM of Italian women GDM was found to be higher with increasing age, prepregnancy overweight, positive history of diabetes short stature (Di, Volpe, et al., 2003). A population based cross sectional study conducted in Australia found increasing maternal age and ethnic factors (non- Caucasian ethnicity) result in increasing GDM rates (Carolan, Davey,et al., 2012). A study conducted in India had the prevalence proportion GDM increased with gravida (Seshiah, Balaji, et al., 2004). There was high prevalence of GDM in multigravida than in primigravida.

1.3.8 Complication of GDM

GDM has adverse effect on both mother and fetus. They are listed as fetal and maternal problem. Fetal complications include macrosomia, neonatal hypoglycaemia, perinatal mortality, congenital malformation, hyperbilirubinemia, polycythaemia, hypocalcaemia, and respiratory distress syndrome. This results from maternal hyperglycaemia causing fetal hyperinsulinemia. Delayed impediments to the young generation of people include an increased risk of glucose intolerance, and obesity. (ADA, 2004; Metzger & Coustan , 1998; Casey , Lucas,et al., 1997; Kjos & Buchanan , 1999)

Maternal factors associated with an increased incidence of macrosomia include hyperglycaemia, (Metzger & Coustan, 1998; Casey,et al., 1997; Kjos & Buchanan , 1999) high BMI, (Ciann, Miccoli et al ., 2003; Di,et al 2003; Casey et al., 1997; Kjos & Buchanan , 1999) ,older age, preeclampsia and multiparity (Ciann, Miccoli et al, 2003; Casey et al .,1997), shoulder dystocia, and an increased rate of caesarean deliveries. More important is women with GDM have an increased risk of developing diabetes after pregnancy when compared to the general population, with a conversion rate of up to 3% per year (Casey et al 1997).

Though some studies show no maternal and fetal complications. In Saudi Arabia Nasrat et al observed 212 women with untreated IGT and same number of women with normal glucose tolerance and concluded that IGT had no adverse pregnancy outcome (Nasrat, Augensen& Shalhoub, 1994). A study in Mauritius by Ramtoola et al., could not find excess perinatal mortality in 267 pregnant women with IGT compared with a background population (Ramtoooola, Home &Damry, 2001).

Whereas, Moses and Calvert (Australia) found the glucose level should be close to normal during pregnancy. They found the there was an association between blood glucose and the proportion of assisted deliveries and the proportion of infants admitted in ward with glucose tolerance (Moses &Calvert, 1995). Ramachandann et al conducted a study in south India GDM pregnancy had high macrosomia and premature deliveries than those who had no GDM (Ramachandran, Snehalatha, Clementina, et al.,1998)

A study conducted in Pakistan showed pre-eclampsia and caesarean delivery was highest with abnormal glucose tolerance test. However for abnormal GCT and normal GTT the incidence of macrosomic child had mounted up (Khan, Hashmi &Rizvi, 1995).

1.3.9 Effects of GDM on maternal and child health

The MDG has clearly stated that 4 and 5 reduce child mortality and improve maternal health respectively. GDM is a warning to both the mother and child. Once detected the treatment has to be started in order to be on a safer side to prevent any serious complication to occur during pregnancy and child birth. The delivery should be safe for the mother and the child as well because GDM causes problem to both.

1.3.10 Maternal and child health service in Nepal

The cost-effective interventions exist across the continuum of maternal to child survival at each level of the health system that can contribute to achieve the Millennium Development Goals 4 and 5. However, implementation inefficiency, low coverage and equity gaps along this continuum remain a serious challenge to Nepal's efforts to achieve these goals (KC, Bhandari, 2011). Due to lack of resources maternal and child health situation is critical. It needs to be worked out from the government level to the grass root level to conduct a safe delivery saving both lives.

Component of antenatal care in public health clinic

1. Proper history taking
2. Height measurement of the pregnant women
3. Weight measurement of the pregnant women
4. General examination of the pregnant women
5. Physical examination for anaemia, jaundice, oedema
6. Vitals has to be taken : BP, Pulse temperature, respiration
7. Fundal height
8. Fetal heart sound
9. Tetanus toxoid vaccination
10. Lab investigation: Hb%, RBG, urine routine and for acetone, blood grouping, etc.
11. Proper information must be given about the pregnancy and also letting them know the danger sign such as fever, burning micturition, foul discharge from vagina eruption of the water bag, less fetal movement etc.
12. USG (Ultrasonography) to see the fetal well-being and the gestation age.

1.4 Relevance (statement of the problem)

People suffering from diabetes, in urban area are more than that in rural area. A survey conducted in urban Nepal between 2001 and 2002 shown that 10.8% suffered from diabetes and 13.2% pre-diabetes respectively in males, and that for females being 6.9% and 10.2%, respectively (Shrestha, Singh, Bhattarai, 2006).

GDM has to be identified timely in order to avoid risk and complication to the mother and the child. In a developing country like Nepal due to proper lack of resources and clinical investigation the pregnant women have to bear serious consequences putting their life at a stake. Initiatives have to be taken for the pregnant women for proper investigation for the type of screening which would identify

the disease on time. Thus help to save the lives of two. Traditionally, after delivery women in Nepal are often prevented from engaging in any activities such as travelling, washing, minor work activities and consuming calorie-rich foods that are high in fat content. This custom, which is accompanied by traditional 'oil massage' may last from a few weeks up to three months. The recent study found an average weight gain is six months after delivery is around 15.9 kg. After few months, it is difficult to loose gained weight. Increased body weight in women of childbearing age puts them at increased risk of developing gestational diabetes in subsequent pregnancies and diabetes later in life (Bhattarai & Singh, 2007). In order to control this situation one needs to identify the risk indicators for GDM

Nepal Diabetic Association has faced difficulties convincing health planners that a vital goal is to prevent of type 2 diabetes. The nutritional status of women must be checked; particularly those of childbearing age and correlate with GDM (Bhattarai & Singh, 2007). Reports claim that 40-66% of early pregnancy can detect GDM; however conflicting studies on glucose screening made it difficulty in detecting GDM on time (Meyer, Carbone et. al, 1996).

1.5 Justification of the study

Gestational Diabetes Mellitus causes life threatening complication to the mother and the child. Prevalent progression of GDM leads to type 2 diabetes in future. GDM is a preventable disease so in order to avoid complication it becomes necessary to identify the risk indicators at the earliest. This would help the mother to take a preventive step for herself and the child as well. The MDG 4 and 5 also states reduce child mortality and improve maternal health. Pregnancy with complication has to be identified and timely action to be taken for safer deliveries by skilled personnel. Saving the two lives are truly a noble deed. It is the duty of the researcher to make the public realize the importance of GDM. Research will let people know the prevalence, risk factors, prevention of the disease. It is very necessary to motivate people regarding GDM.

There are very few studies conducted in Nepal in regard to GDM so people are not aware of the disease. They lack total knowledge about this disease. The person who knows also does not know very well. There is no proper data about its aetiology, prevalence, risk factors, and prevention on this disease. Due to lack of information for the providers they also could not generate the exact information to the target population. Right information on GDM has to be given to all the pregnant mothers. As already told the studies done in Nepal were few it is the right of the Nepalese citizen to get to know the disease in the best possible way.

1.6 Research question, hypothesis and study objectives

1.6.1 Hypothesis

1. There is a high prevalence of gestational Diabetes Mellitus in Nepal.
2. The risk indicators of GDM are advancing maternal age, overweight and obesity, reduce physical activity, positive family history, previous positive history of GDM , diet (non vegetarian diet)

1.6.2 Research question

1. What is the prevalence of GDM in urban antenatal clinic in Nepal?
2. What are the risk indicators and association with GDM in Nepal?

1.6.3 Objectives of the study

Primary objective

To determine the prevalence of gestational diabetes mellitus in urban antenatal clinic in Nepal.

Secondary objectives

1. To examine the difference in prevalence of GDM in normal and overweight mother
2. To explore the GDM in the context of socio demographic status such as age, economic status, family history, parity, education, physical activity, diet.

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Chapter 2

Material and method

2 Material and method

2.1 Target population

The target population was pregnant woman of reproductive age (15-49) years visiting antenatal clinic at KMC (Kathmandu Medical College).

2.2 Study population

The study population was pregnant women between 24 and 28 weeks gestation who are coming to the Kathmandu medical college and teaching hospital for their antenatal check-ups.

2.3 Study design

A hospital based cross sectional study was designed for the collection of the data. The study design was purely quantitative and observational. The data was collected from only one hospital. The necessary information was collected from the participants through the prepared set of questionnaire. The question was asked individually to each participant.

2.4 Study hospital

The data was collected from participants visiting Kathmandu medical and teaching hospital for antenatal check-ups.

2.5 Research tool/instrument

The research tool used for the data collection was

i. Questionnaire (Appendix 2)

2.6 Source of data

i. Answers given by the participants to the questionnaire

ii. Antenatal record book

iii. Lab investigation report

iv. Height and weighing machine kept at KMC.

2.7 Inclusion criteria

i. Reproductive age from (15-49) years, pregnant woman.
ii. Pregnant women between 24 and 28 weeks of gestation
iii. Pregnant women who are eligible and willing to take part in the study.

2.8 Exclusion criteria

i. Significant maternal diseases like connective tissue diseases, endocrine diseases, asthma, chronic liver disease etc.
ii. Frank diabetes (Diabetes prior to pregnancy).
iii. Twin or multiple pregnancy.

2.9 Sample size determination of primary study

Calculation is done in the following way;

$n= Z^2 \times PQ/d^2$

n = required sample size

Z = confidence level at 95% (standard value of 1.96)

P = estimated prevalence of GDM is about 6.3% (Jiwani , Marseille , Nicolai et.al , 2012)

Q=1-P i.e. 0.72

d = margin of error i.e. (0.05)

Formula:

$n= = Z^2 \times PQ/d^{2=}$ $(1.96)^2(.06)\ (1-0.06)/\ (0.05)^2$

$=3.84*.06*0.94/\ 0.0025$

$=86.67$

Estimated response rate is 80 %i. e. 0.8

86.67/0.8= 108 (required sample size).

Sample size

The sample size of the participants was 510 during the field work period.

2.10 Sampling procedure

Data was collected from the research participants who were eligible for the study.

2.11 Data collection procedure

Training was given to the research personnel prior to the data collection. The training was focused on the demonstration to fill the questioner, collection of the data from the antenatal card. The way of communication with research participants and ethical issues were also discussed during the training period. The personals were also given information about the GDM in case the participant would like to know about GDM and its consequences.

The main theme of the study was explained to the participants all the information given by the research participants was thoroughly reviewed to collect the required information. For some the husband accompanied and asked the question on the behalf of their wives. The data was regularly cross check by the principal investigator.

2.12 Diagnostic criteria used

We depend on the method adopted by the KMC hospital for screening GDM. All pregnant women of gestation age between 24 and 28 weeks have to go for 50gm GCT. If the result of GCT $\geq$ 140mg% then had to undergo 75 gm OGTT. The GDM was diagnosed after performing OGTT based on WHO criteria.

2.13 Variables

The only dependent variable is GDM. All other variables used are independent variable.

I. Socio demographic risk factor for mother-age, education qualification, occupation status of women, monthly income of women, physical activity

II. Anthropometrical factor- height ,prepregnancy weight, BMI(Body Mass Index)

III. Obstetrical risk factor- parity, , previous bad obstetrical history

IV. Familial risk factor- previous history of GDM, previous positive history of diabetes and first degree relatives.

V. Bio chemical variable – RBG, FBG, GCT OGTT,

2.14 Time of diagnosis of GDM

Gestational week at which GDM was diagnosed

2.15 Type of treatment in GDM

For GDM patient if blood sugar detected high admitted and managed conservatively Firstly dietary control, if not by diet then insulin supplement is given. Then they were kept in regular follow ups.

2.16 Pregnancy outcome variable

2.16.1 primary outcome

To know the prevalence of gestational diabetes mellitus.

2.16.2 Secondary outcome:

To identify whether GDM is associated with maternal age, body mass index, occupation, physical activity, education, positive family history, diet.

2.17 Operational definition of variables

Maternal age- age of the mother at the time of pregnancy

Maternal height- height recorded in the antenatal card/ taken in the height machine

Maternal weight(pre pregnancy)-weight of the mother prior to pregnancy

BMI- Body Mass Index weight in kg ^{2} divided by height in m^2

Physical activity- depends on the time spent on the physical activity or house hold activity or other activity such as walking, working in the office.

Education qualification-until what level he/she has studied in the studying institution.

Illiterate- those who have never gone to school and literate those who have gone to school.

Occupational status- women who do not earn anything are referred as house wife. Women who had their income are referred as employed. Women who are studying are referred to as student.

Monthly expenditure- the monthly salary earned in Nepalese rupees.

Gravid – number of times she has become pregnant including abortion, still birth, intrauterine death.

Parity – number of live child she has delivered.

Bad obstetrical history- it relates to miscarriage, obstructed labour or any serious complication during pregnancy, during delivery etc

Abortion- death of the fetus before 24 weeks of gestation

2.18 Anthropometrical measurements

Anthropometric measurements of height and weight of pregnant women were taken wearing light clothes and without shoes. Height was taken while the woman stands in erect posture, touching the occiput, back, hip, and heels on a straight measuring wall, while she looks straight ahead. Then Weight was recorded to the nearest 0.1 kg weighing machines placed on a flat surface. Body mass index was calculated by the weight in (Kg) divided by height in (m^2).

2.19 Measurement of blood pressure

For measuring the blood pressure (BP), special precaution was taken to reduce the variation of BP value with resting blood pressure. The women were asked to take rest for at least 5 minutes in sitting position before measuring the BP if they were exerted. Then the pressure was measured on the right arm using normal cuffs for adult fitted with a standard sphygmomanometer placing the stethoscope bell lightly over the brachial artery. Blood pressure was recorded to the nearest 2 mmHg from the top of the mercury meniscus. Systolic pressure was recorded at the first appearance of sounds, and diastolic pressure was measured at phase V, which is the disappearance of sounds.

2.20 BMI- Body Mass Index

Around 6 kg is weight gain during pregnancy by the end of second trimester is normal (Dutta, 2004).

Pre-pregnancy BMI can be calculated as follows

1. In the pregnant women with the known pre-pregnancy weight, BMI is calculated by weight- to height ratio of kg/m^2.

2. In those with unknown pre-pregnancy weight, BMI can be calculated by subtracting the measured weight by expected weight gain in normal pregnancy (Institute of Medicine [IOM], 2009).

During pregnancy, the mother is encouraged to gain 3 kgs over the first 20 weeks and 0.5 kg every week until term. So, an average of 10-13 kgs of weight is gained during pregnancy. Generally, little weight is gained during the first trimester .The most weight is gained during 2nd trimester followed by the 3rd trimester.

For calculation of weight to be subtracted from current weight to calculate pre-pregnancy BMI if BMI was unknown prior to pregnancy.

- Up to 20 weeks of gestation: Subtract 3 kgs from current weight
- >20 weeks of gestation: Subtract 3.0 kgs plus 0.5 kg/week

Categorization of BMI was accordance with recommendation for Asia-Pacific region by Western Pacific Regional Office of WHO (WPROWHO, 2000). The steering committee of the regional office for the western pacific region of WHO). .

Categories	BMI (kg/m^2)
• Underweight	<18.5
• Normal weight	18.5-22.9
• Overweight at risk	23-24.9
• Obese I	25-29.9
• Obese II	30

In our study, we broadly divided into 2 categories, Underweight and normal weight in category I and overweight and obese in category II. The cut off points for BMI of underweight and Normal weight is <22.9 kg/m^2, cut off points for overweight and obesity is >23kg/m^2 is taken.

2.21 Data handling

In order to avoid mixing of data separate coding was done. The data was entered one by one by observing at the each questionnaire. The software package used was SPSS 20 (statistical package

for social science). The data was created on the answers to the questionnaire and also the antenatal card. Medical records were viewed thoroughly for the required information.

2.22 Statistical analysis

SPSS version 20 is used to calculate frequency, distribution for maternal age, socio demographic factors, obstetrical history, familial histories and other variables as well. By using numbers and percentages data are summarized. Means, standard deviation are calculated for continuous variable (age, BMI). Univarate analysis was done to determine the crude odds ratio (ORs) and 95% CI. Multivariate logistic regression is carried out for evaluation of effect modification. Correlation coefficient and logistic regression analysis will also be tested for observing association between GDM and BMI, GDM and diet. The analyses include descriptive and both univariate and multivariate binary logistic regression. Proportion and chi-square test are used to explore the relationship between maternal ages, parity, and positive family history for diabetes. Statistical inference is based on 95% confidence intervals (CIs) and the significance level is set at p value ≤ 0.05.

2.23 Ethical issues

Ethical review committee in Norway (REK) and Nepal Health Research Council (NHRC) gave the ethical approval to conduct a study The ethical approval was taken from the respective hospital to perform the study.

Informed written consent was taken from the participants. Appendix 1. The participants were told about the purpose and objective of the study. Participants were told that they could withdraw from the study any time, no reasons were asked about leaving the study. The given data were secured with confidentiality. That participant who could not write consent was taken from the witness.

2.24 Data collection procedures and tools

The principal investigator obtained the necessary information from the participants through the questionnaire. The research team were given training prior going to the field to get to know the research objectives and the matters concerning the ethical issues. Besides they should be well known about the disease to answer the participants' queries. A preliminary survey on data collection procedures and tools helped to get the necessary data required for the study. The reliability of the answers by the participants was counter check from the antenatal cards and the

medical records which participant bought to the hospital for their check – ups.

2.25 Data Handling and record keeping

2.25.1 Confidentiality:

The information from participants was kept confidential and managed according to the existing rules of institutional review committee is done. This was very important.

2.25.2 Records retention:

Any tool regarding the study was destroyed at the completion of the study in accordance with the Health documentation destruction policy of institutional review committee.

2.26 Potential risks

As it is a cross sectional, there are no physical potential risks to research subjects. There may be risks associated with confidentiality.

2.27 Potential benefits

The findings will help to know the prevalence of gestational diabetes mellitus, associated risk indicator, monitor disease trends, and build an environment that will be helpful to encourage healthy lifestyles through various approaches, inter-disciplinary associations.

2.28 Conflict of interest:

There is no potential conflict of interest in this study.

Chapter 3

Results

3 Result

3.1 Descriptive analyses

Table 1 Descriptive characteristics of the study participants

	GDM		
Covariate	Yes	No	Total
n (%)	22 (4.3)	488 (95.7)	510
Age in years (Mean ± SD)	27.73 ± 4.18	25.55 ± 4.03	25.64 ± 4.06
BMI (Mean ± SD)	27.21 ± 3.04	25.02 ± 3.36	25.12 ± 3.37
Prevalence of GDM			**95% CI with GDM**
Occupation:			
Housewives	13 (2.5)	315 (61.8)	(1.5- 4.3)
Employed	8 (1.6)	141 (27.6)	(0.8- 3.1)
Student	1 (0.2)	32 (6.3)	(0.03- 1.1)
Economic:			
≤30000	15 (2.9)	407 (79.8)	(1.8- 4.8)
>30000	7 (1.4)	81 (15.9)	(0.7- 2.8)
Education:			
Illiterate	0	14 (2.7)	
Literate	22 (4.3)	474 (92.9)	(2.9- 6.4)
Physical activity:			
≤5hours	4 (2.7)	374 (73.3)	(1.6- 4.6)
6 hours	8 (1.6)	114 (22.4)	(0.8- 3.1)
*Parity:			
Primi	10 (2.2)	251 (54.9)	(1.1- 3.6)
1 child	9 (2)	165 (36.1)	(0.9- 3.3)

2 or more	1 (0.2)	21 (4.6)	(0.03- 1.1)
Maternal age groups:			
≤20 years	1 (0.2)	51 (10)	(0.03- 1.1)
21-30 years	15 (2.9)	384 (75.3)	(1.8- 4.8)
31+ years	6 (1.2)	53 (10.4)	(0.5- 2.5)
BMI:			
18.5-22.9	2 (0.4)	153 (30)	(0.1- 1.4)
≥23	20 (3.9)	335 (65.7)	(2.6- 6.0)

[*]2 GDM + cases had abortion

Table 1 shows the descriptive characteristics of the study participants. A total of 510 women with an overall mean age of 25.64 years (± 4.06) and an average BMI of 25.12 (± 3.37) were enrolled during the study period. All women completed the study.

The prevalence of GDM in urban antenatal clinic in Nepal is approximately 4.3%. As shown in Table 1, the prevalence is higher among housewives (2.5%) than among women who are employed (1.6%) and among female students (0.2%). Housewives with GDM 95%CI (1.5-4.3). The study also showed that women from households earning more than Rs. 30000 had a lower prevalence of 1.4% while the prevalence was estimated at 2.9% for women from households with earnings of less than Rs.30000 with 95%CI (0.7-2.8) and (1.8-4.8) respectively. For those who are literate, the prevalence of GDM is 4.3% and 95% CI (2.9-6.4). Pregnant women who do 5 hours or less physical activity per day, have high prevalence of 2.7 % whereas women who work for at least 6 hours have a prevalence of 1.6%. The prevalence is high for women in the age group 21- 30 years (2.9%) and lowest in the age group ≤ 20 years (0.2%). Women in the age group 31 and above have a prevalence of 1.2%. Women who were pregnant for the first time have a GDM prevalence of 2.2 % [95% CI (1.1, 3.6)] whereas women with 1 or at least 2 children have prevalence of 2% and 0.2% respectively. The estimated prevalence of GDM for women with a BMI < 22.9 kg/m^2 is 0.4% and it is quite high in women with BMI >23 kg/m^2 (3.9%) with 95% CI (0.1-1.4) and (2.6-6.0) respectively.

3.2 Risk indicators of GDM

Table 2 Odds ratios (OR) and their 95% CI showing the risk factors associated with GDM

Covariate (risk factors)	Univariate		Multivariate	
	OR (95% CI)	P-value	OR (95% CI)	P-value
Ref age group: 21 – 30 years				
≤ 20 years	0.50 (0.06- 3.88)	0.5	0.93 (0.11- 8.31)	0.9
31+	2.90 (1.08- 7.79)	0.03	3.32 (1.07- 10.26)	0.03
Ref occupation: Housewives				
Employed	1.38 (0.56- 3.39)	0.4	0.56 (0.14- 2.28)	0.4
Students	0.76 (0.10- 5.98)	0.7	1.05 (0.12- 9.29)	0.9
**Ref income: 10000-30000 Rs				
>30000	2.35 (0.93- 5.93)	0.07	2.43 (0.89- 6.66)	0.08
Time referent: <5 hours				
≥ 5 hours	1.88 (0.77- 4.58)	0.1	2.42 (0.61- 9.59)	0.2
Ref parity: Primi				
1 child	1.37 (0.55- 3.44)	0.5	1.04 (0.37- 2.91)	0.9
2^+ children	1.20 (0.15- 9.79)	0.17	0.52 (0.05- 5.10)	0.5
Ref BMI: 18.5-22.9 kg/m^2				
≥ 23 kg/m^2	4.57 (1.05- 19.79)	0.04	3.42 (0.76- 15.38)	0.1

** Income in Nepali rupees.

Table 2 shows results from binary logistic regression models; univariate (unadjusted) model and multivariate (adjusted) model. The risk of GDM among the 31+ age group is 2.90 times [95% CI (1.08, 7.79)] compared to women in the 21 – 30 age group. This risk increased to 3.32 [95% CI

(1.07, 10.26)] after controlling for income, occupation, physical activity, parity and BMI. Overweight and obese women whose BMI≥23Kg/m^2 are at a higher risk of developing GDM with an odds ratio of 4.57[95% CI (1.05, 19.79)]. However this effect disappeared after adjusting for the other risk factors. The analysis did not reveal differences between women in occupations, economic status, physical activity and parity.

3.3 Effect of diet on BMI

Table 3 Prevalence of obesity between vegetarians and non-vegetarians

	BMI		GDM	
	18.5-22.9	≥23	Yes	No
Vegetarian	15 (2.9)	21 (4.1)	4 (0.8)	32 (6.3)
Non-vegetarian	140 (27.5)	334 (65.5)	18 (3.5)	456 (89.4)

3.4 Effects of diet and age on both BMI and GDM

Table 4 Binary logistic regression for the effects of diet and age on BMI and GDM

	BMI		GDM	
	OR (95% CI)	P-value	OR (95% CI)	P-value
Ref: Vegetarian				
Non-vegetarian	1.70 (0.85- 3.40)	0.13	3.08 (1.00- 9.79)	0.05
Ref: 21 – 30 years				
≤ 20 years	0.33 (0.19- 0.60)	< 0.01	0.51 (0.07- 3.97)	0.52
31+	2.68 (1.23- 5.82)	0.01	2.86 (1.06- 7.76)	0.04

Table 3 shows the prevalence of obesity and GDM among vegetarians and non-vegetarians. The prevalence is very low among vegetarians (4.1%) compared to non-vegetarians (65.5%). Non-vegetarians have higher prevalence of GDM than vegetarians. The effects of diet and age on both BMI and GDM are presented in Table 4. Here, the risk for being obese was 70% higher among non-vegetarians compared to vegetarians after adjusting for age. The study also showed that non-vegetarians were 3-fold likely to develop GDM as compared to vegetarians. With age, the risk for developing GDM increased. The risk is 2.86 [95% CI (1.06, 7.76)] times among the 31+ age group compared to 21-30 age groups. However, the risk of developing obesity is lower by 67% among women in the age group ≤ 20 compared to women in the age group 31+ and it is 2.68 times higher in the age group 31+.

Chapter 4

Discussion

4 Discussion

The purpose of the study was to determine the prevalence and associated risk indicators of GDM in Nepal. Knowledge about the prevalence and risk factors of GDM would help in giving early warnings to people and prevention measures established.

4.1 Discussion on the findings of the study

Risk indicators for GDM

In our study we found increasing maternal age is risk for GDM. The mean age for GDM is 27.73± 4.18 The age specific prevalence was higher in 21- 30 group was about 2.9%. In the age group 31+ years the risk is nearly 2.9 folds higher compared to 21-30 age groups. After controlling for income, occupation, physical activity, parity and BMI the risk increased to 3.32 fold with 95% CI [1.07-10.26]. With advancing age the risk of getting GDM also rises. The chance is 2.86 with 95 %(1.06-7.76) times in 31 over age group as related to 21-30 years group. There were 86.7% of women age 25 years or more had GDM (Begum, Huda et al., 2002). Multiple studies showed that GDM had an association with increasing age, higher parity, higher pre-pregnancy weight and BMI, history of diabetes in first degree relatives, past history of gestational diabetes in various studies (Seshiah, Balaji, et.al, 2004; Zargar et al., 2004; Seshiah et al., 2008; Metzger et al., 2007; Xiong, Saunders, & et al., 2001). A study in Hariyana showed prevalence of GDM increased significantly with increasing age (Rajput, Yadav & et al, 2013). In Pakistan also diagnosed by O'Sullivan criteria half of the women with GDM were 25-30 years (Jawad & Irshaduddin, 1996). Though in our study, no association was seen with other variables except for increasing age and in overweight and obese pregnant mothers. This is due to less number of positive cases of GDM.

Pregnant women ≤20 years have least prevalence rate of 0.2%. There is less chance of developing GDM in younger age group than in advancing age. Mother's mean age at birth in Nepal is 20.1. The median age at first birth among women in Nepal is 25-29(WFB, 2014). Total fertility rate is 2.3 children born/woman.

The prevalence of GDM for BMI i.e. ≥23 is 3.9% with 95% CI (2.6, 6.0) and <23 the estimated prevalence is 0.4% with 95% CI (0.1-1.4). The risk of having ≥23kg/m^2 of BMI is 4.57 times higher than having low BMI of <23kg/m^2, however disappeared after adjusting for other risk indicators. In our study GDM was found to be significantly higher in women with higher BMI and

higher pre-pregnancy weight .Others' studies states that obesity is an important risk factor in the development of GDM (Seshiah et al., 2008; Torloni, Betran, et.al, 2009). Higher prevalence of GDM in women with higher BMI has also been observed in earlier studies as well (Seshiah, et al., 2008; Swami, Mehetre, et.al. 2008, Torloni, Betran, et.al. 2009). Saldana *et al* (Saldana, Siega-Riz, Adair & Suchindran, 2006) observed that weight gain was significantly higher in women with gestational diabetes than in those with normal blood glucose. Bo *et al* (Bo, Menato, Signorile, Bardelli, et al., 2003) had observed that hyperglycaemia in pregnancy was a risk factor for excess gestational weight gain.

We found the prevalence of obesity in non-vegetarian is 65.5% and that of vegetarian is 4.1%. About 3.5% of non-vegetarian have GDM and those for vegetarian the prevalence is 0.8%. Our research showed there was 70% risk of being obese for non-vegetarian than vegetarian after adjusting for age. Non vegetarians are 3 times likely to develop GDM than vegetarians. Diet composition may be a modifiable predictor of risk for abnormal glucose tolerance during pregnancy. Previous studies suggest that diets high in total fat, saturated fat, red and processed meats, and with high glycogenic load increase the risk of developing GDM, while polyunsaturated fats, carbohydrates and fibers are protective (Jenny, Emilyo et al,2008). Jali (2011) al found that non-vegetarian pregnant women (61.5%) were more susceptible to develop abnormal glucose tolerance. It may be due to high fat, high calorie and low fiber diet. Recently, some of the studies have examined diet quality during pregnancy as a potentially modifiable contributor to GDM risk (Bo, Menato et al, 2001; Wang, Storlien et al., 2000; Saldana, Siega, 2004). In particular, Saldana et al (Salmeron, Manson et al., 1997) showed that higher intake of fat and lower intake of carbohydrates may be associated with increased risk of GDM and impaired glucose tolerance (IGT). High fiber intake, which has been consistently linked to decreased risk of type 2 diabetes mellitus among non-pregnant adults (Schulze, Liu et al., 2004; Meyer, Kushi et al., 2000;Montonen , Knekt et al., 2003) was related to lower risk of GDM in two studies. Moses et al found that high intake of fatty diet lead to recurrent GDM in subsequent pregnancy compared to women in whom GDM did not recur (Moses, Shand et al., 1997; Zhang, Liu et al., 2006).

The GDM prevalence was 4.3% for educated women in our study. Though education did not show any significance but a significantly higher prevalence of GDM was observed in other's studies with increasing educational level. This could be because of higher age of these women. Innes *et al* (Innes, Byers et al., 2002) had found an inverse association between the educational level of the pregnant woman and gestational diabetes mellitus. In another study carried out in Italy high levels of maternal education were found to be associated with reduced risks of GDM,

compared to less educated women (Bo, Marchisio, & et al., 2003). Similar to our studies, study conducted byYang *et al* (Yang, et al, 2002) did not find an association between GDM and education in Chinese pregnant women.

The prevalence was estimated 2.9 for those whose household earning was less than 30000. A significant association of gestational diabetes mellitus was seen with socio-economic status of the participants. This association could be related to multiple factors such as higher maternal age, higher pre-pregnancy weight and BMI, more sedentary lifestyle in women of higher socio-economic status. In our study we did not find any association with socio economic status, similarly Yang *et al* (Yang et al, 2002) did not find such an association in Chinese pregnant women while Keshavarz *et al* (Keshavarz , Cheung , et al., 2005) found an association between GDM with low socio-economic level in pregnant Iranian women (Bo et al., 2003).

Family history of diabetes mellitus has been reported to be associated with higher chances of developing GDM(Seshiah , et al., 2008; Zargar , et al., 2004; Swami , Mehetre , Shivane ,et.al., 2008; Kim , Liu , Valdez & Beckles, 2009). Seshiah (2008) observed a significant association between the family history of diabetes mellitus and the occurrence of GDM among pregnant women. A significant association between history of GDM in previous pregnancy and development of GDM in the index pregnancy was seen, though the number of women with past history of GDM was small (McGuire, Rauh, et al., 1996). The reason for not finding the significant association is due to low statistical power or the number of positive GDM cases is small in number. There was β error or type 2 error in our study.

4.2 Methodological consideration

4.2.1Study design

A hospital based cross sectional study was conducted at Kathmandu medical college and teaching hospital. Today people are health conscious so they go to hospital for regular check-ups. On the other hand it also becomes easier for the researcher to conduct a hospital based study as it has become a convenient way to get the required data from the pregnant women.

4.2.2 Selection of hospital

Due to some internal problems at other hospitals, data was collected from Kathmandu medical college and teaching hospital only.

4.2.3 Diagnostic criteria of GDM

We could not take the fasting blood sample as per protocol because the women were not willing to do so after being invited. Thus we relied on data that was collected by the hospitals. All pregnant women undergo 50gm GCT at 24 to 28 weeks of gestation. If GCT ≥140mg% then OGTT was performed to confirm GDM.

4.2.4 Sampling technique and sampling size

All eligible pregnant women coming to the hospital between 24 and 28 weeks of gestation were recruited for study

4.2.5 Response of the participants and data collection

The interview depended mainly on the participants' information. There was no system to check participants' personal details such as birth registration, medical records. Sometimes the reports could have been misleading because of recall bias. We had to rely on the antenatal cards and the story of the participants.

4.3 Methodical discussion

4.3.1 Strength of the study

The principal investigator obtained the data from the participants. Adequately trained assistants helped to collect data and respond the queries of participants. A study measures the exposure and disease occurrence at the same point in time. The analysis was done individually. Multiple effects of the risk indicators can be tested at the same time. Multiple exposure and determinants can be studied nicely. Cross checking and validating forms and data entry was done finely otherwise reliability of the results would be influenced. This study can be taken as reference since very few studies has been conducted in Nepal. As I am a medical person it has been easy to win their confidence to take part in the research. A cross sectional study is particularly suitable for estimating the prevalence of a behavior or disease in a population and my main objective is to estimate the prevalence.

4.3.2 Limitation of the study

The cross section study limits the underlying interference between exposure and disease outcome.

4.3.2.1 Confounding factor

The positive sample for GDM was small enough to see the association, so for most of the variable the result showed insignificant. It was difficult to measure the time relationship in our study.

4.3.2.2 Biases

Selection bias

The sample collected was from only one hospital and non-random sampling technique caused potential limitation on the selected samples only. The patient coming to the hospital represented a part of the general population for antenatal check-ups.

Recall and reporting bias

There was a greater chance of recall bias as participants forget to recall their past. To some questions participants feel embarrassed for which they hide the truth for instance abortion cases, age etc., this leads to reporting bias.

Interview bias

Questionnaire is stereotype so participant may feel uncomfortable to answer. Inconsistency in questioning may occur. First impression error so participants have feared to answer the question though everything has been told.

4.4 Internal validity of the findings

The research is based on the hospital record that has been collected from the client's antenatal card. The questionnaire is prepared by the researcher herself.

4.5 External validity for generalization

The findings of the study are based on pregnant women between 24 and 28 weeks of pregnancy coming from village and municipality area to the respective hospital for the check-up**.**

4.6 Reliability

The question is asked directly to the client. This allows the information lacking in the questionnaire can be corrected. Collecting data in a prospective way is helpful doubt can be clarified.

Chapter 5

Implication, conclusion , Recommendation

5.1 Implication of our study

Our study can be used for further studies on diabetes and GDM. The antenatal clinics can have the zest on GDM so pregnant women are aware of the disease. This study can also be used as campaign for preventing obesity for GDM and DM.

5.2 Conclusion

The prevalence of GDM was found to be 4.3% in KMCTH, Kathmandu. There need to be appropriate intervention to control GDM and also risk indicator modification s in order to avoid complication regarding to mother and child. Every clinician must do through check-ups or follow ups GDM cases after delivery to avoid from developing type 2 diabetes. GDM is a major health challenge for both mother and the child. So it is a duty of a doctor to treat it in the best possible way to lower maternal and fetal complications.

In summary, our study showed that advancing maternal age, overweight and obesity were a risk indicator for GDM. However, other risk indicators should not be neglected because multiple studies showed that they were also equally important risk factors for GDM. We could not find an association with important risk indicators possibly because of low statistical power. Timely check-ups and screening is recommended.

5.3 Recommendation

1) All pregnant women should visit the hospital/clinic/ health post for antenatal check-ups.
2) Screening for GDM must be performed compulsory to all pregnant mothers.
3) A proper guideline for GDM must be formulated so no pregnant women should be devoid from screening.
4) If GDM diagnosed, proper management should be performed to avoid complication.
5) Proper monitoring of the GDM patient who are taking insulin therapy.
6) GDM patient should be followed up post-partum for blood glucose status and required advised should be given to them.
7) GDM patient should not avoid health status of self and it is the right of her to get to know

the disease well so to get to aware of the consequences.

6. Further research obligatory

1) Our study found the increasing age is risk factor for GDM, so better to see the cut off age of the mother acquiring GDM.
2) A study on GDM with grades of hypertension among pregnant women in Nepal
3) GDM with modes of delivery and assessment of maternal and fetal outcome.
4) Chance of having type 2 diabetes to GDM mothers in subsequent pregnancies.
5) Promotion of health lessening the burden of disease by controlling GDM

References

7. Reference lists

American Diabetes Association [ADA] (2004): Gestational diabetes mellitus (Position Statement). *Diabetes Care* 27 (Suppl. 1):S88–S90.

Begum, S., Huda, S.N., Musarrat, N. Ahmed, S.& Ali, S.M.(2002) nutritional status birth outcomes of diabetic and non-diabetic pregnant women. *Bangladesh Med Res Coun Bull; 28*(3):97-103

Beischer, N.A., Oats, J.N., Henry, O.A., Sheedy, M.T. & Walstab, J.E. (1991): Incidence and severity of gestational diabetes mellitus according to country of birth in women living in Australia. *Diabetes 40* (Suppl. 2):35–38,

Ben- Haroush, A., Yogev, Y. & Hod M. (2004) epidemiology of gestational diabetes mellitus and its association with type 2 diabetes. Diabet Med 21(2): 103-113

Bhattarai, M.D., Singh, D.L. (2007). Learning the lessons – preventing type 2 diabetes in Nepal. Diabetes Voice 52 (2): 9-10.

Bo, S., Menato, G., Lezo, A, Signorile, A., Bardelli, C., Massobrio, M.,and et al.(2001) Dietary fat and gestational hyperglycaemia. Diabetologia. 44(8): 972-978.

Bo, S., Marchisio, B., Volpiano, M., Menato, G. & Pagano, G. (2003). Maternal low birth weight and gestational hyperglycemia. Gynecol Endocrinol.; 17:133–6.

Bo, S., Menato, G., Signorile, A., Bardelli, C., Lezo, A., Gallo, M.L., et al. (2003) Obesity or diabetes: what is worse for the mother and for the baby? Diabetes Metab. 29:175–8.

Buchanan, T.A., Xiang, A.H. (2005) Gestational Diabetes Mellitus. *J clin invest 115*(3):485-491

Carolan, M., Davey, M. A., Biro, M.A., and et al. (2012). Maternal age, ethnicity and Gestational Diabetes Mellitus. *Midwifery28* (6):778-783DOI10.1016/j.midw. 2011.08.014

Casey, B.M., Lucas, M.J., McIntire, D.D., Leveno, K.J. (1997). Pregnancy outcomes in women with gestational diabetes compared with the general obstetric population. *Obstet Gynecol 90*:869 -873

Central Bureau of Statistics (2012). Nepal in figures. *National Population and Housing Census 2011 (National Report).* Government of Nepal, National Planning Commission of Secretariat, Central Bureau of Statistics Kathmandu, Nepal.

Chu, S.Y., Callaghan, W.M., Kim, S.Y. and et el.(2007) Maternal obesity and risk of gestational diabetes mellitus. *Diabetic care vol. 30(8)*:2070-2076. DOI: 10.2337/dc06-2559a.

Cianni, G.D., Miccoli, R., Volpe, L., Lencioni, C & Del Prato S (2003): Intermediate metabolism in normal pregnancy and in gestational diabetes. *Diabetes Metab Res Rev* 19:259–270.

Di Cianni G., Volpe L., Lencioni, C., Miccoli, R., Cuccuru, I.,et al.(2003) prevalence and risk factor for gestational diabetes assessed by universal screening. *Diabetes Res lin Prac 62*(2):131-137

Divakar,H., Tyagi, S., Hosmani, P & Manyonda, I.T.(2008) Diagnostic criteria influence prevalence rates for gestational diabetes: implications in an Indian pregnant population .

Doery, J.C., Edis, K., Healy, D., Bishop, S. & Tippett, C. (1989). Very high prevalence of gestational diabetes in Vietnamese and Cambodian women (Letter). *Med J Aust* 151:111.

Dornhorst, A., Paterson, C.M., Nicholls, J.S., Wadsworth, J., Chiu, D.C., Elkeles, R.S., Johnston, D.G. & Beard, R.W.(1992). High prevalence of gestational diabetes in women from ethnic minority groups. *Diabet Med* 9: 820–825.

Dulal,R.K. & Karki, S.(2009) Disease management programme for Diabetes mellitus in Nepal. *J Nepal Med Assoc 48:281*-6.

Dutta, D.C. (2004) editor. Textbook of obstetrics. 6th ed. New Central Book Agency (P) Ltd; Physiological changes during pregnancy; p. 50.

Green, J.R., Pawson, I.G., Schumacher, L.B., Perry, J. & Kretchmer, N. (1990) Glucose tolerance in pregnancy: ethnic variation and influence of body habitus. *Am J Obstet Gynecol* 163:86 –92.

Hanna, F.W.F. & Peters, J.R. (2002) Screening for gestational diabetes; past, present and future. *Diabet Med* 19: 351–358.

IDF, (2013). International Diabetes Federation. *IDF Diabetes Atlas 6th edition*. Brussels, Belgium.

Innes, K.E., Byers, T.E., Marshall, J.A., Baron, A., Orleans, M. & Hamman, R.F.(2002) Association of a woman's own birth weight with subsequent risk for gestational diabetes. JAMA; 287:2534–41.

Institute of Medicine (IOM), (2009). Weight gain during pregnancy: reexamining the guidelines. Washington, DC: National Academies Press.

Ishak, M. & Petocz, P. (2003). Gestational diabetes among Aboriginal Australians: prevalence, time trend, and comparisons with non-Aboriginal Australians. *Ethn Dis* 13: 55–60.

Jali, M.V., Desai, B.R., Gowda, S., Kambar S., Jali, S.M. (2011). A hospital based study of prevalence of gestational diabetes mellitus in an urban population of India. Eur Rev Med Pharmacol Sci., 15(11):1306-10

Jawad F and Irshaduddin P.K. Prevalence of gestational diabetes and pregnancy outcome in Pakistan Eastern Mediterranean Health Journal .1996; 2(2):268-273

Jenny, S.R., Emily, O. Sheryl L.R., Ken P.K., Janet, W.R., Matthew, W.G. (2008) Diet during early pregnancy and development of gestational diabetes. Paediatr Perinat Epidemiol, 22: 47-59.

Jiwani, A., Marseille, E., Nicolai, L., Damm, P., Hod, M., & Kahn, J.G. (2012) Gestational diabetes mellitus: results from a survey of country prevalence and practices *The Journal of Maternal-Fetal and Neonatal Medicine*; 25(6): 600–610 © Informa UK, Ltd. ISSN 1476-7058 print/ISSN 1476-4954 online DOI: 10.3109/14767058.2011.587921

KC, A., Bhandari, A., Pradhan, Y.V., Upreti S.R., Thapa, K. et al. (2011). State of Maternal, Newborn and Child Health Programmes in Nepal: What May a Continuum of Care Model Mean for More Effective and Efficient Service Delivery? *J Nepal Health Res Counc* Oct; 9(19):92-100

Keshavarz, M., Cheung, N.W., Babaee, G.R., Moghadam, H.K., Ajami, M.E. & Shariati, M. (2005) Gestational diabetes in Iran: incidence, risk factors and pregnancy outcomes. *Diabetes Res Clin Pract*; 69:279–86.

Khan, K.S., Hashmi, F.A. & Rizvi J.H.(1995) are non- diabetic women with abnormal glucose screening test at increased risk of pre-eclampsia, macrosomia and caesarean birth? *J Pak Med Assoc ;45*(7):176-179

Kim, C., Liu, T., Valdez, R. & Beckles, G.L.(2009) Does frank diabetes in first degree relatives of a pregnant woman affect the likelihood of her developing gestational diabetes mellitus or nongestational diabetes? *Am J Obstet Gynecol*, 201(576):e1–6.

Kjos, S.L. & Buchanan, T.A. (1999) Gestational diabetes mellitus. *N Engl J Med* 341:1749–1756.

McGuire, V., Rauh, M.J., Mueller, B.A. & Hickock, D. (1996). The risk of diabetes in a subsequent pregnancy associated with prior history of gestational diabetes or a macrosomic infant. Paediatr Perinat Epidemiol ; 10:64–72.

Metzger, B.E. & Coustan, D.M. (1998) Organizing Committee: Summary and recommendations of the Fourth International Workshop-Conference on Gestational Diabetes Mellitus. *Diabetes Care; 21*:Suppl. 2:B161–B167.

Metzger, B.E., Buchanan ,T.A., Coustan, D.R., Levia, A.D., Dunger, D.B., Hadden, D.R. & et al. (2007) Summary and recommendations of the Fifth International Workshop-Conference on Gestational Diabetes Mellitus. *Diabetes Care,* 30:S251–60.

Meyer K.A., Kushi L.H., Jacobs D.R. Jr., Slavin J., Sellers T.A., Folsom A.R. (2000) Carbohydrates, dietary fiber, and incident type 2 diabetes in older women. *Am J Clin Nutr; 71*(4): 921-930.

Meyer,W.J., Carbone, J., Gauthier, D.W. & Gottmann, D. A. (1996). Early gestational glucose screening and gestational diabetes. *J Reprod Med*;41(9):675-679

Montonen, J., Knekt, P., Jarvinen, R, Aromaa, A., Reunanen, A.,(2003) Whole-grain and fiber intake and the incidence of type 2 diabetes. *Am J Clin Nutr 77*: 622-629.

Moses, R.G. & Calvert, D. (1995) Pregnancy outcomes in women without gestational diabetes mellitus related to the maternal glucose level. Is there a continuous risk? *Diabetes care, 18(*12):1527-1533

Moses, R.G., Shand J.L., Tapsell L.C. (1997). The recurrence of gestational diabetes: could dietary differences in fat intake be an explanation? *Diabetes Care 20*: 1647-1650.

Nasrat, A.A., Augensen, K. & Shalhoub, J.T. (1994) the outcome of pregnancy following untreated impaired glucose tolerance. *Int J Gynaecol Obstet, 47*(1):1-6

Qiao, Q., Nakagami, T., Tuomilehto, J., Borch-Johnsen, K., Balkau, B., Iwamoto, Y. & *et al.* (2000). The DECODA Study Group on behalf of the International Diabetes Epidemiology Group. Comparison of the fasting and the 2-h glucose criteria for diabetes in different Asian cohorts.*Diabetologia* ; 43: 1470-1475

Rajput,R., Yadav, Y., Nanda, S. & Rajput, M.(2013, April) Prevalence of gestational diabetes mellitus & associated risk factors at a tertiary care hospital in Haryana. *Indian J Med Res 137*(4), pp 728-733.

Ramachandran, A., Snehalatha, C., Clementina, M., Sasikala, R. & Vijay, V. (1998) fetal outcome in gestational diabetes in south India. *Diabetes Res Clin Pract ;41*(3): 185-189

Ramtoooola, S., Home, P. & Damry, H., Husnoo, A. (2001). Gestational impaired glucose tolerance does not increase perinatal mortality in a developing country; cohort study *BMJ; 322*(7293):1025-1026. DOI10.1136/bmj.322.7293.1025.

Saldana, T.M., Siega-Riz, A.M., Adair, L.S. & Suchindran, C. (2006) The relationship between pregnancy weight gain and glucose tolerance status among black and white women in central North Carolina. *Am J Obstet Gynecol, 195:1629*–1635.

Saldana, T.M., Siega-Riz, A.M., Adair, L.S. (2004) Effect of macronutrient intake on the development of glucose intolerance during pregnancy. *Am J Clin Nutr, 79*: 479-486

Salmeron, J., Manson, J.E., Stampfer, M. J., Colditz, G.A.,Wing, A.l., Willet, W.C.(1997). Dietary fiber, glycemic load and risk of non-insulin dependent diabetes mellitus in women. JAMA; 277:472-477.

Schulze, M.B., Liu, S., Rimm, E.B., Manson, J.E., Willett, W.C., Hu, F.B. (2004). Glycemic index, glycemic load, and dietary fiber intake and incidence of type 2 diabetes in younger and middle-aged women. *Am J Clin Nutr, 80*: 348-356

Seshiah, V., Balaji, V., Balaji, M.S., Sanjeevi, C.B. & Green, A. (2004) Gestational diabetes mellitus in India. *J Assoc Physicians India 52*: 707-11.

Seshiah,V., Balaji, V., Balaji, M.S., Paneerselvam, A., Arthi, T., Thamizharasi, M. & et al.(2008). Prevalence of gestational diabetes mellitus in South India (Tamil Nadu) - a community based study. *J Assoc Physicians India,* 56:329–33.

Sharma, P.K. & Shrestha, A. (2010, May-Aug) Gestational Diabetes Mellitus: A prospective study. *South Asian federation of obstetrics and gynaecology, 2*(2):109-113

Shrestha, A., Chawla, C.D. (2011). The glucose challenge test for screening of gestational diabetes. *Kathmandu Univ Med J; 34(2)22-6*

Shrestha, U.K., Singh, D.L. & Bhattarai, M.D. (2006). The prevalence of hypertension and diabetes defined by fasting and 2-h plasma glucose criteria in urban Nepal. *Diabet Med; 23*:1130–1135.

Singh, D.L., Bhattarai, M.D. & Maskey, A. (1995) Demographic profile of diabetic patients admitted in medical wards of Bir Hospital, Nepal, 1990 to 1994. *International Diabetes Digest.* Cambridge: FSG Communications Limited & International Diabetes Federation; 6; 4: 87-88.

Solomon, C.G., Willett, W.C., Carey, V.J., Rich- Edwards, J., Hunter, D.J., Colditz, G.A., Stampfer, M.J., Speizer, F.E., Spiegelman ,D. & Manson, J.E. (1997). A prospective study of pregravid determinants of gestational diabetes mellitus. *JAMA* 278:1078–1083, 1997

Swami, S.R. , Mehetre, R., Shivane, V., Bandgar, T.R. , Menon, P.S. & Shah, N.S. (2008) Prevalence of Carbohydrate intolerance of varying degrees in pregnant females in western India (Maharastra) – a hospital based study. *J Idnian Med Assoc* . *106*(11): 712-4, 735.

Thorpe, L.E., Berger, D., Ellis, J.A., Bettegowda, V.R., Brown, G., Matte, T., Bassett, M. & Frieden, T.R. (2005). Trends and racial/ethnic disparities in gestational diabetes among pregnant women in New York City, 1990–2001. *Am J Public Health* 95:1536–1539.

Torloni, M.R., Betran, A.P., Horta, B.L., Nakamura, M.U., Atallah, A.N., Moron, A.F. & et al.(2009) Prepregnancy BMI and the risk of gestational diabetes: a systematic review of the literature with meta-analysis. *Obes Rev.*10:194–203.

Wang, Y., Storlien, L.H., Jenkins, A.B., Tapsell, L.C., Jin, Y., Pan, J.F., Shao Y.F., Calvert, G.D., Moses, R.G., Shi, H.L., Zhu,X.X.(2000) Dietary variables and glucose tolerance in pregnancy. *Diabetes Care, 23*: 460-464.

WHO[World Health Organisation], (2013). Diagnostic Criteria and Classification of Hyperglycaemia First Detected in Pregnancy. WHO/NMH/MND/13.2

Wild, S.H., Roglic, G., Sicree, R., et al. Global Burden of Diabetes mellitus in the Year 2000. (2010 October 15) [Online] 2004. Available from: h t t p: / / w w w 3. wh o

World fact book [WFB] (2014.1.16);https://www.cia.gov/library/publications/the-world-factbook/.../np.html

World Health Organization (1999). Definition, diagnosis and classification of diabetes mellitus and its complications. Part 1: diagnosis and classification of diabetes mellitus. Department of Non communicable Disease Surveillance, Geneva. Report No.: WHO/NCD/NCS/99.2.

WPRO, (2000). The steering committee of the regional office for the Western Pacific Region of WHO.

Xiong, X., Saunders, L.D., Wang, F.L. & Demanczuk, N.N. (2001). Gestational diabetes: prevalence, risk factors, maternal and infant outcomes. *Int J Gynaecol Obstet*; 75:221–8.

Yang, X., Hsu-Hage, B., Zhang, H., Yu, L., Dong, L., Li J., Shao, P. & Zhang, C. (2002) Gestational diabetes mellitus in women of single gravidity in Tianjin City, China. *Diabetes Care; 25:847*–851.

Zargar, A.H., Sheikh, M.I., Bashir, M.I., Masoodi, S.R., Laway, B.A., Wani, A.I., Bhat, M.H., Dar, F. A. (2004) Prevalence of gestational diabetes mellitus in Kashmiri women form the Indian subcontinent. *Diabetes Res Clin Pract. 66* (2): 139 –145.

Zhang, C, Schulze, M.B., Solomon, C.G., Hu F.B. (2006) A prospective study of dietary patterns, meat intake and the risk of gestational diabetes mellitus. Diabetologia, 49(11): 2604-2613.

Zhang, C., Liu, S., Solomon C.G., Hu, F.B.(2006) Dietary fiber intake, dietary glycemic load, and the risk for gestational diabetes mellitus. *Diabetes Care 29*: 2223-2230.

Appendices

Appendix 1

Informed consent form for pregnant woman

You are being invited to participate in a Gestational Diabetes Mellitus Research study. This form is designed to provide you with information about the study. The investigators or representative describes this study to you and answer any of your questions. .I am going to give you information and invite you to be part of this research. You do not have to decide today whether or not you will participate in the research. Before you decide, you can talk to anyone you feel comfortable with about the research. There may be some words that you do not understand. Please ask me to stop as we go through the information and I will take time to explain. If you have questions later, you can ask them of me, the study doctor or the staff.

Title of project: "Prevalence of Gestational Diabetes Mellitus and associated risk indicator in urban antenatal clinic in Nepal"

Gestational diabetes mellitus is increasingly dramatically worldwide in the recent decades. It is one of the causes of maternal and fetal mortality and morbidity. Nearly half of women with a history of GDM go on to develop type 2 diabetes within five to ten years after delivery. It develops in 1 in 25 pregnancies worldwide and is associated with complications in the period immediately before and after birth. **.**

Potential risks

As it is a cross sectional, there are no physical potential risks to research subjects. There may be risks associated with confidentiality.

Potential benefits

The findings will help to know the prevalence of gestational diabetes mellitus, associated risk indicator monitor disease trends, and build an environment that will be helpful to encourage healthy lifestyles through various approaches, inter-disciplinary associations.

This is to certify that I…… hereby agree to participate as a volunteer in an authorized research project.

I understand the purpose of this research as mentioned above. The procedure involves determining the prevalence of gestational diabetes mellitus and associated risk indicator among pregnant women between 24-28 weeks of pregnancy. I also know that beside routine health check-ups for blood tests and ultrasonography. I also will have to perform Oral glucose tolerance test.

I understand that all the information which is obtained from me will be confidential in an appropriate manner.
Participation is voluntary and I understand that I am free to refuse to participate in a procedure or to refuse to answer any question at any time without prejudice to me. I understand that I am free to withdraw my consent and to withdraw from the study any time without prejudice to me.
I understand that the research investigators named above will answer any of my questions about the research procedures, my rights as a subjects and research-related injuries time.
I have read the foregoing information, or it has been read to me. I have had the opportunity to ask questions about it and any questions that I have asked have been answered to my satisfaction. I consent voluntarily to participate as a participant in this research.

Print Name of Participant_____

Signature of Participant _____

Date _____

Day/month/year

If illiterate

A literate witness must sign (if possible, this person should be selected by the participant and should have no connection to the research team). Participants who are illiterate should include their thumb-print as well.

I have witnessed the accurate reading of the consent form to the potential participant, and the individual has had the opportunity to ask questions. I confirm that the individual has given consent freely.

Name of witness_____ **AND** **Thumb print of participant**

Signature of witness _____

Date _____

Day/month/year

Statement by the researcher/person taking consent

I have accurately read out the information sheet to the potential participant, and to the best of my ability made sure that the participant understands that the following will be done:

1.

2.

I confirm that the participant was given an opportunity to ask questions about the study, and all the questions asked by the participant have been answered correctly and to the best of my ability. I confirm that the individual has not been coerced into giving consent, and the consent has been given freely and voluntarily.

A copy of this ICF has been provided to the participant.

Print Name of Researcher/person taking the consent_____

Signature of Researcher /person taking the consent_____

Date _____

Day/month/year

Note: If you have any questions or complaints about the informed consent process or policy, please contact investigators (s). **Thank you!**

Appendix 2

Questionnaire

1. Date ---------- Code No. ----------

2. Personal History

2.1. Name of the Patient ----------

2.2. Wife of, Daughter of ----------

2.3. Age ----------Years

2.4. Marital status - (Married / Single / Widow)

2.5. Occupation ----------

3. Address

3.1 Permanent Address

House No. ---------- Street ---------- Ward No. -------

Village/Municipality ---------- District----------

3.2 Temporary Address

House No. ---------- Street ---------- Ward No. -------

Village/Municipality ---------- District----------

3.3 Contact no. Office ---------- Residence ----------

2.8. Education ----------

2.9 Education of Husband ----------

3. Personal History

3.1. Family History (Yes =1, No =2, Unknown=3)

	1. DM			2. HTN			3. IHD		
	1	2	3	1	2	3	1	2	3
Grand parents									
Father									
Mother									
Brother/sister									
Sons/daughters									

3.2. Physical activity (hours/day) ----------

4. History of Past illness

4.1.

SL	**Name of Diseases**	**(Yes =1, No =2, Unknown=3)& date of diagnosis**	**Are you currently taking any medication (1. Yes 2. No)**	**Medicine Name**
1	Diabetes			
2	High blood pressure			
3	Stroke			
4	Heart Attack			
5	Foot ulceration			

5. Obstetric History

5..1 Total number of children ----------

5.2. Number of Miscarriages/ Abortions ----------

5.3. Number of Still Births ----------

5.4. Modes of Delivery – Normal/ caesarian / Vaccum / others

5.5. Cause of cesarian /vaccum in past delivery ----------

5.6. Weight of baby in previous delivery ----------

5.7. Any congenital abnormality----------

5.8. Any type of sickness during pregnancy----------

5.9. Age of last child----------

6. Menstrual History

6.1. Menstrual cycle ----------

6.2. Duration of flow ----------

7. Physical examination

7.1. Blood Pressure ---------- mmHg

7.2. Height ---------- cm

7.3. Weight ---------- Kg

8. Blood test result

Name of the test	**Result**
FPG (mg/dl)	
Oral glucose tolerance test (mg/dl)	
Total Cholesterol	

TG	
HDL	
LDL	
Hemoglobin	

9. Food habit

9.1. Total number of meal ----------

9.2. Most of the time type of meal taken ----------

Appendix 3 questionnaire in Nepali

प्रश्नावली

१. मिति ..... कोड न. .....

२ व्यक्तिगत विवरण

२.१ नाम .....

२.२ थरियानको नाम .....

२.३ उमेर .....

२.४ वैवाहिक अवस्था – विवाहित / अविवाहित / विधवा

२.५ पेशा .....

२.६ आर्थिक अवस्था .....

२.७ ठेगाना .....

गाविस / न.पा ..... जिल्ला .....

२.८ फोन नं. (मोबाईल) ..... घर .....

२.९ शिक्षा .....

२.१० पतिको शिक्षा .....

२.११ धर्म .....

३ व्यक्तिगत विवरण

	1. DM			2. HTN			3. IHD		
	Y	N	U	Y	N	U	Y	N	U
बुबा									
आमा									

३.१ परिवारिक विवरण –बुवापति Paternal (Yes =Y, No =N, Unknown=U)

	1. DM			2. HTN			3. IHD		
	Y	N	U	Y	N	U	Y	N	U
दाजे									
भाई									
दाई भाई									
बिहे बहिनि									

३.२ पारिवारिक विवरण – आमाथति (Yes =Y, No =N, Unknown=U)

		1. DM			2. HTN			3. IHD		
		Y	N	U	Y	N	U	Y	N	U
बाजे										
बज्यै										
बाउ	भाई									
दिदी	बहिनि									

३.३ शारीरिक कृयाकलाप (घण्टा/हप्ता) .....

घरायसी ..... घण्टा

कामको लागि अवस्थित ..... घण्टा

अतिरिक्त समय ..... घण्टा

४. विगतको स्वास्थ्य अवसथा

४.१

SL	Name of Diseases	(Yes =Y, No =N, Unknown=U)& date of diagnosis	Are you currently taking any medication Yes(Y) No(N)	Medicine Name
१	मधुमेह			
२	उच्च रक्तचाप			
३	स्ट्रोक			
४	हर्ट एटयाक			
५	अन्य			

५ Obstetrics History

५.१ बालकालिकाको संख्या.....

५.२ बच्चा खेर गएको संख्या.....

५.३ मृत बच्चा जन्मेको संख्या.....

५.४ अन्तिम बच्चाको जन्म – सामान्य/शल्यक्रिया/भ्याकुम/अन्य.....

५.५ शल्यक्रिया/भ्याकुम गर्नुको कारण (पछिल्लो बच्चाको) .....

५.६ बच्चाको तौल (अन्तिम सुत्केरी).....

५.७ पछिल्लो सुत्केरीमा कुनै किसिमको अपाङ्गको बच्चा .....

४.८ पछिल्लो सुत्केरीमा कुनै किसिमको रोग लागे जस्तै उच्च रक्तचाप रोग .....

४.९ पछिल्लो गर्भवती समयमा कुनै किसिमको रोग लिनु भएको थ .....

४.१० सानो बच्चाको उमेर .....

५ अन्तिम महिनावारी .....

६.१ महिनावारी चक्र .....

७. शारीरिक परिक्षण

७.१ रक्तचाप .....

७.२ उचाई .....

७.३ तौल .....

७.४आमाको जन्मदाको तौल .....

८ रक्त परीक्षण

Name of the test	Result
GCT (mg/dl)	
FPG (mg/dl)	
Oral glucose tolerance test (mg/dl)2hr PP	
Haemoglobin (gm/dl)	
Ultrasonography(Fetal Weight)	
Blood group	

९ खाद्य विवरण

खाना	नियमित	कहिले काहि	कहिले खाएन
भात			
दाल			
तरकारी			
दही			
हरियो सागपात			
फलफूल			
मकै			
मासु			
तैलिय पदार्थ			
गेडागुडी			
अण्डा			

Appendix 4

Consent form in Nepali language

मन्जुरीनामा फारम

गर्भावस्थामा हुने Gestational Diabetes Mellitus को अध्ययनमा भाग लिनुहुन अनुरोध छ । यदि सो रोग सम्बन्धि कुनै जिज्ञासा छ भने अनुसन्धानकर्ता वा प्रतिनिधिलाई सम्पर्क गर्नुहोला ।

विषय : Prevalence of Gestational Diabetes Mellitus & associated risk indicator in urban antenatal clinic in Nepal

अनुसन्धानकर्ता.....

ठेगाना.....

फोन.....

म..... Gestational Diabetes Mellitus भएका विषयमा गरिने अध्ययनमा स्वइच्छाले सहभागी हुन चाहन्छु ।

उल्लेखित रोग २४--२८ हप्ताका गर्भवती महिलाहरुमा अध्ययन गरिनेछ ।

यदि गर्भवती सम्बन्धि नियमित जाँच बाहेक विहान खाली पेटमा रगत फिक्नुका साथै १५० ग्रा को ग्लुकोज घोलेको पानी पिउन पर्ने हुन्छ । ग्लुकोज पानी पिएको २ घण्टापछि रगत परिक्षण गर्नुपर्ने हुन्छ ।

मैले सम्पूर्ण विवरण बोध्य गरिने कुरा बुझाई अवगत छु ।

मेरो सहभागिता स्वइच्छाले हो र जुनसुकै बेलामा पनि म सहभागिता हटाउन सक्छु ।

मेरो आफ्नो मन्जुरीनामा जुनसुकै बेला पनि कितां लिन म स्वतन्त्र छु । कितांकारे म संग कुनै प्रकार दण्ड र कुनै किसिमको कानुन लागु हुने छैन ।

मेरो सम्पूर्ण जिज्ञासाको प्रति उत्तर अनुसन्धानकर्ता वा प्रतिनिधिले दिने छ ।

मेरो जानेको बखत मेरो मन्जुरी नामको प्रति लिन सक्छु ।

सहभागिताको नाम :

सहि .....

मिति .....

साक्षी .....

स्थान .....

नोट : यो मन्जुरीनामा सम्बन्धि कुनै प्रश्न वा जिज्ञासा भएमा अनुसन्धानकर्ता वा प्रतिनिधि सम्पर्क गर्नुहोला । धन्यवाद ।